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1947

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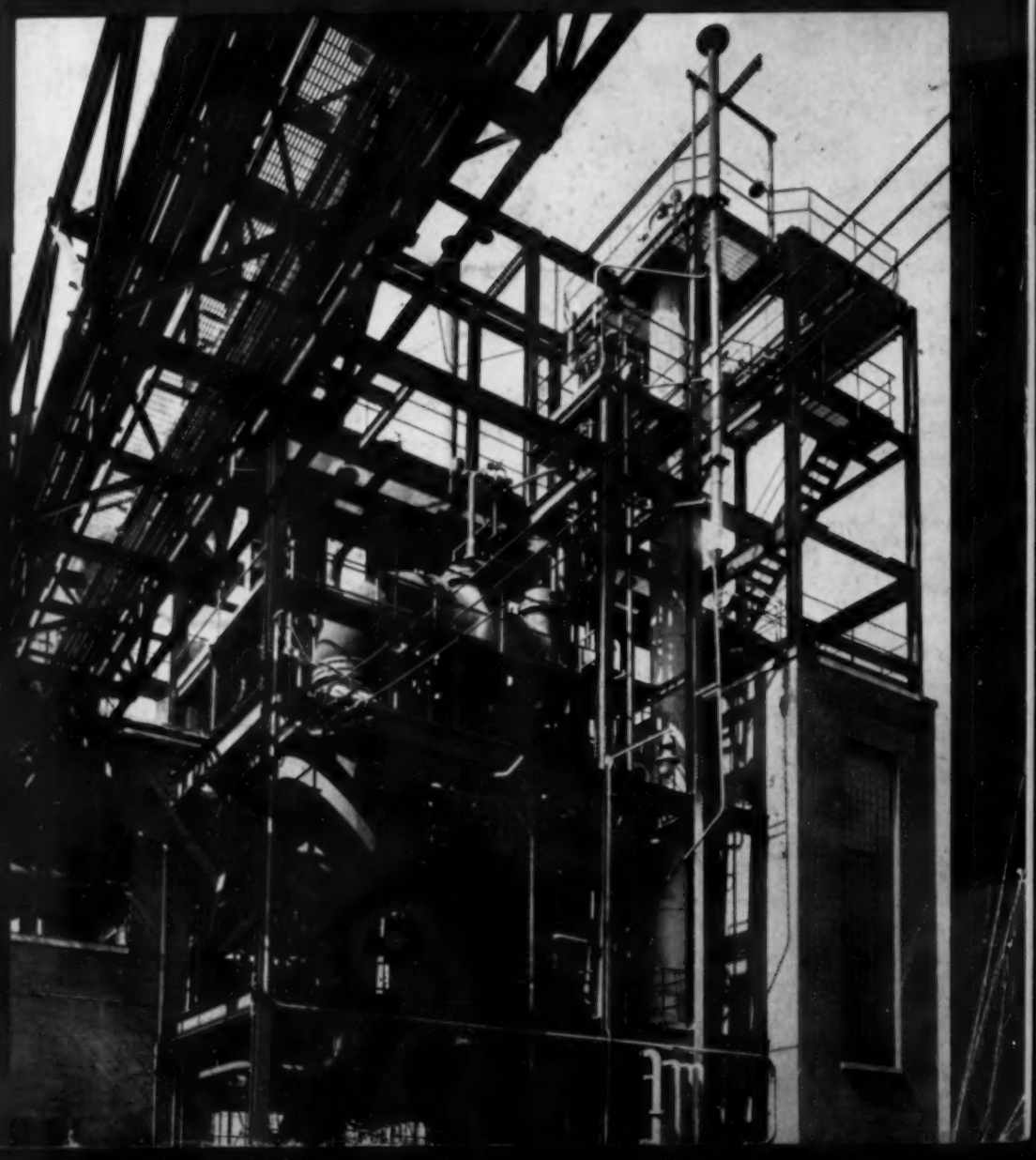

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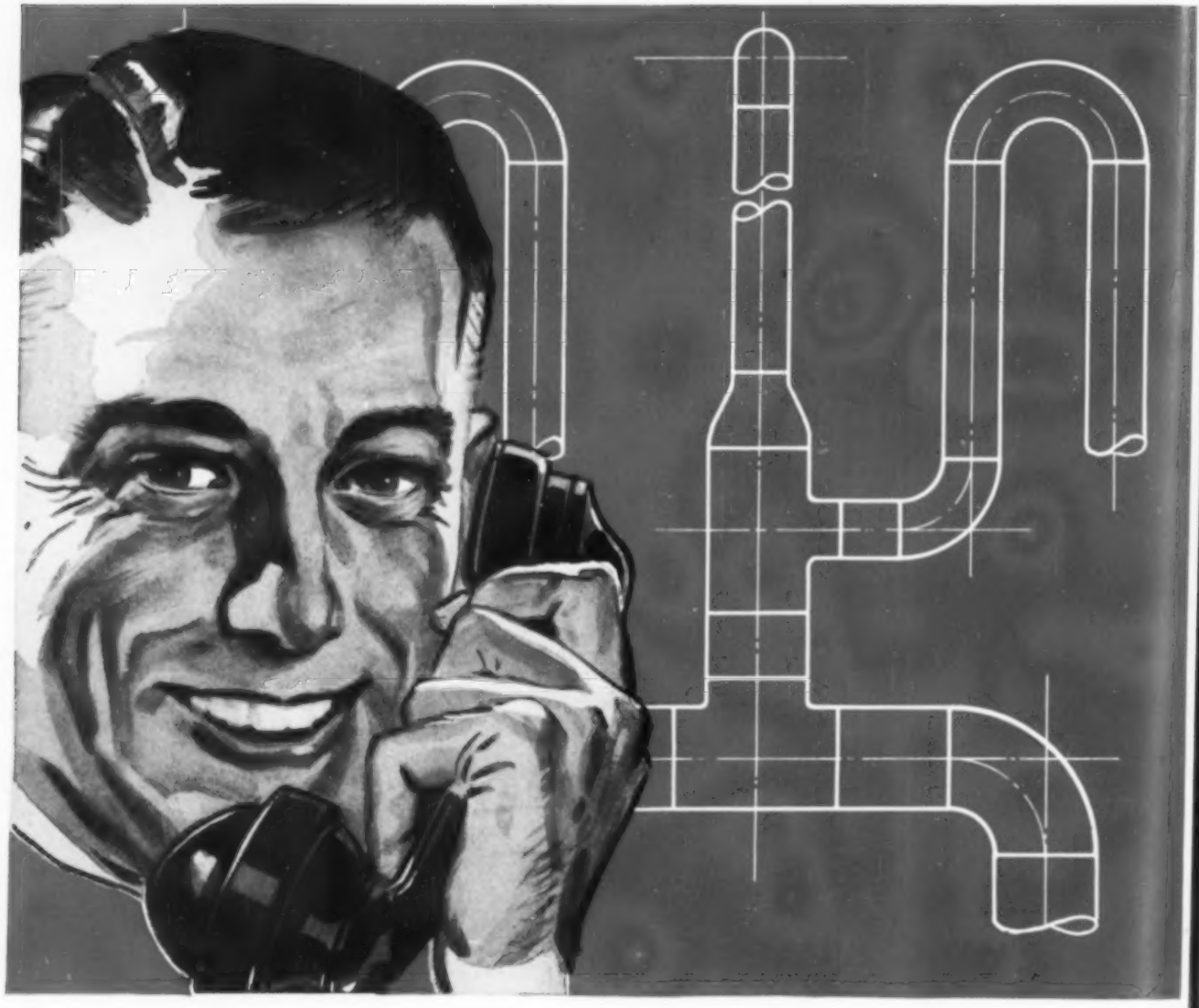

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Volume 54 Number 4

APRIL 1947

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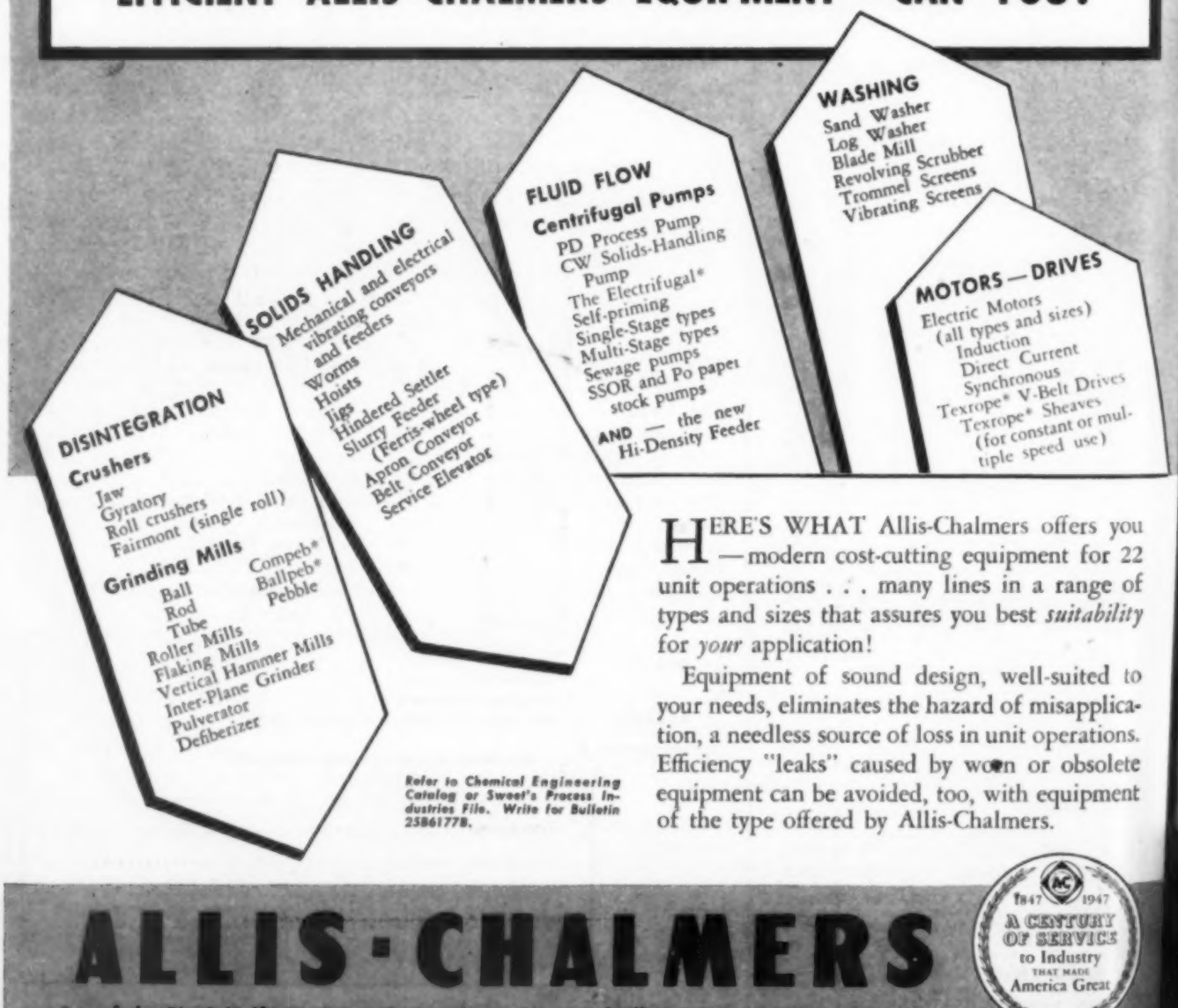

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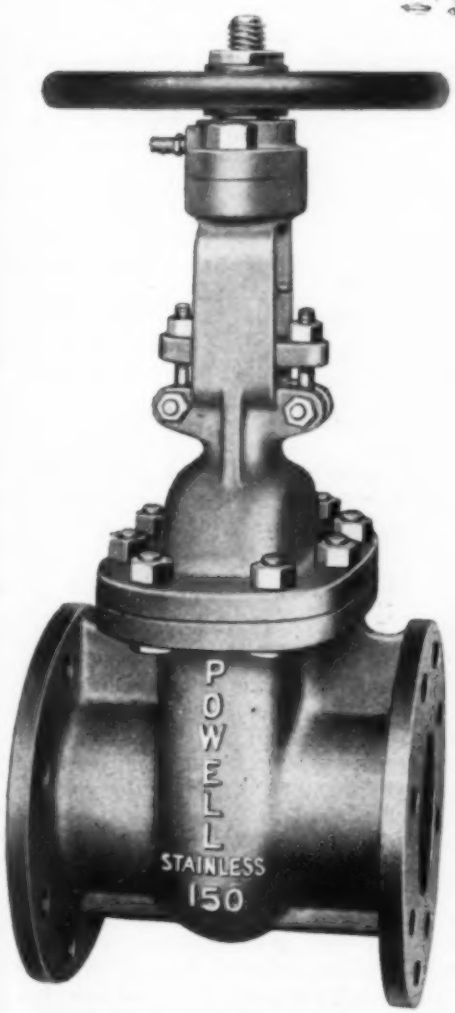

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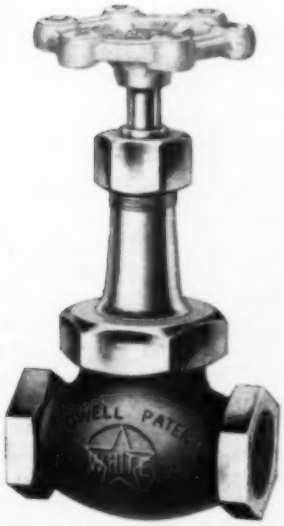

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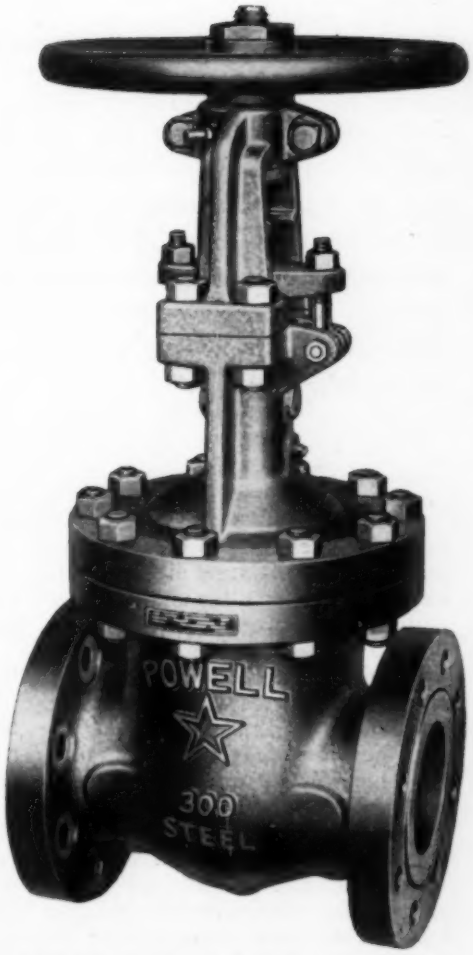

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VALVES

WATCHING WASHINGTON

R. P. McBride, EDITORIAL CONSULTANT
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Census of Manufactures on 1947 operations will depend on Congressional appropriations . . . More commodities added to list for consideration of tariff cuts at Geneva convention . . . Most rubber controls will be kept pending permanent legislation . . . Changes sought in methods of distributing fertilizer nitrogen . . . Chemical manufacturers warned against possible power shortage . . . FTC asks legislation to prevent mergers . . . Minerals industry advisory committee forming . . . After June 30 neither potash nor phosphate will be under allocation.

Census Plans

RUMORED among the cuts to be made for the sake of economy are some of Census fats and oils statistics. Reports, issued monthly and quarterly during the war, would drop back at least to quarterly and annual periods, if not eliminated altogether. At least one bill in the Senate would make mandatory, and somewhat more elaborate, the collection of fats and oils data on a monthly basis. However, prospects for such legislation are dubious.

Census of Manufactures on 1947 operations still depends on Congressional appropriations. After the money is available, administrative decisions within Census will determine the degree of detail which can be secured, and the emphasis which will be placed on specific commodity data compared to over-all economic data. Those desiring specific commodity statistics should make their wants known to Census at an early date.

New Tariff Policy

MANY more commodities will be subject to tariff cuts under a plan announced in March when the State Department and U. S. Tariff Commission made public a further list of goods on which tariff reduction will be considered at the Geneva conference. A number of chemicals were included in the list and a few other products of process industry.

Negotiations have struck one snag because Russia and some of its satellites are not expected to participate in the trade conference. This means that Uncle Sam can not make a tariff cut with the "principal country of supply" as has been customary. Hence it is proposed that if the group as a whole includes suppliers of half of our imports or potential imports of an item, an arrangement will be made with one of the group for the benefit of all.

This "free trade" philosophy is bitterly criticized by those who want some measure of continued tariff protection for American enterprise. But it appears that protests will not prevail. The Geneva conference is confidentially expected to prepare a list of United States tariff reductions covering a vast majority of the imported goods which other nations wish to offer. The President presumably will approve such recommendations without question despite shrieks from Capitol Hill and from potentially distressed industry.

Some Plants Retained

IN MOVING to protect the synthetic rubber industry Congress has specified that until permanent rubber legislation is passed, there shall not be declared surplus and sold plants and facilities costing the government over $5 million. Exceptions to this prohibition are listed as the neoprene rubber plant at Louisville, Ky.; the styrene plants; the petroleum butadiene unit at Toledo, Ohio; two of the three alcohol butadiene plants; and the butadiene-styrene copolymer plants to the extent that the combined actual capacity of such synthetic rubber plants remaining in government hands shall not be less than 600,000 long tons per year.

Total capacity of the copolymer plants is estimated at around 880,000 tons annually. The stipulation of Congress that capacity to the extent of 600,000 tons be retained reflects the recommendation of the Interagency Policy Committee on Rubber last year that there should be kept in operation or standby condition general-purpose synthetic rubber capacity to the extent of 600,000 tons per year.

Rubber Reserve officials report that of plants costing over $5 million, three of the five styrene plants have already been sold, those at Velasco, Tex., Texas City, Tex., and Kobuta, Pa., having been bought by Dow Chemical, Monsanto Chemical and Koppers respectively. Also, one of the synthetic rubber copolymer plants, that at Louisville, Ky., has been sold to Goodrich.

Plants costing $5 million or less consist of five small petroleum butadiene units, some of which have been scrapped, and some miscellaneous subsidiary equipment.

Most Rubber Controls Stay

EXISTING Government controls—allocation, specifications and inventories—over natural and synthetic rubber will remain in effect either until Mar. 31, 1948, or until permanent legislation supporting the domestic synthetic rubber industry is passed. This decision was reached by Congress last month after little opposition in either the House or Senate. Likewise continued in the act were import controls over synthetic rubber and natural- and synthetic-rubber products. Also, the authority of the government to continue research in and manufacture and sales of synthetic rubber was continued, such authority running either until the passage of permanent legislation or to Mar. 31, 1948.

At the same time, Congress discontinued government purchasing of natural rubber at the end of last month after representatives of all government rubber agencies and the War and Navy Departments had expressed their support of this move. Some of the rubber goods manufacturers had argued for an extension of this practice, but they found few supporters in the government.

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The next move will be efforts to frame permanent legislation. The bill enacted last month calls for the completion of a Congressional study of the subject early enough to permit passage of such legislation during the first session.

Nitrogen Badly Snarled

NITROGEN supply during the fertilizer year ending in June has involved expensive and unnecessary cross haul of nitrogen materials, according to critics of government policies. Spokesmen of nitrogen-producing units are urging insistently that there be no repetition during the 1947-48 fertilizer year.

Principal blame for the difficulty is placed on the rulings of International Emergency Food Council which still continues to be dominant in planning fertilizer programs, as well as food projects. Washington wonders whether IEFC will be permitted to dominate nitrogen controls for the next year; but there seems no doubt that some measure of official regulation of scarce nitrogen compounds will be continued. Department of Agriculture is expected to be the domestic regulatory agency.

Most controversial is the question of supply and distribution of solid nitrogen carriers which are physically feasible of long-distance transport. Approximately 540 thousand tons of such nitrogen carriers were utilized during the fertilizer year soon ending, in the forms of cyanamide, ammonium sulphate, ammonium nitrate, and sodium nitrate. Of this total available about 90 thousand tons of nitrogen came as imported Chilean nitrate. Exported were approximately 65 thousand tons of nitrogen, of which 50 thousand tons were in ammonium nitrate made principally at arsenals under arrangements with the Army. The remainder of the export was ammonium sulphate.

Costly Cross Haul

IMPORT from Chile and simultaneous export of equivalent materials often necessitated, according to critics, very expensive cross haul, needless burden for freight cars, and excessive cost to tax payers as well as farmers. The average cost to farmers was approximately $1.42 per unit for domestic ammonium nitrate as compared with $2.62 per unit of nitrogen in Chilean nitrate.

American producers of nitrogen compounds are urging that all these burdens be avoided by allowing domestic use of all domestic production and transfer of Chilean nitrate direct to foreign destinations to the extent to which those areas must have nitrogen for food production. Obviously the recipient areas do not like the proposal. At present they are getting ammonium nitrate free from the Army and they do not willingly shift to purchase from Chile. It is claimed that even if the United States had to buy the Chilean nitrate and deliver it to the destinations, the cost to American tax payers would be less and price of nitrogen to American farmers would be cut by more than 40 percent on the quantity substituted.

European producers also are proposing a program for U. S. nitrogen participation. It is alleged they wish to ship their nitrogen to the United States to get dollar credits (admittedly urgently needed) as a beginning in their re-establishment of nitrogen cartel operations. Simultaneous shipment from U. S. to Europe would, of course, be required. Critics of the past program admit that they fear this, as well as continuance of past policy, "because the State Department has a strangle hold and seems to have no interest in American producers or American farmers."

Power Shortage Seen

CHEMICAL manufacturers using large amounts of electrical power will be interested in views, expressed a few weeks ago in Washington, by Assistant Commissioner Kenneth Markwell of the Bureau of Reclamation. Markwell believes that in the next few years there will be a shortage of power in many localities.

Markwell says that "All power-producing agencies, both public and private, will be required to avert a severe power shortage during the next few years. Lack of new construction, obsolescence, and deferred maintenance during the war created a situation which may become more serious in meeting load requirements than it was during the war. No individual agency, I assure you, will be able to supply more than a portion of the ultimate demand, so rapidly is the American power market expanding."

ODT Drives for More Cars

FACED with the fact that the current rate of retirement of obsolescent freight cars continues to exceed the monthly production of new carriers, the Office of Defense Transportation, last month, held a series of emergency meetings with railroads, car builders and steel manufacturers. Decision in ODT is that production of new cars must be pushed to 10,000 per month by July if requirements of the chemical industry and other groups are to be met this year. CPA's estimate in January that a monthly output of 7,000 would be needed in 1947 is considered too low.

Car builders have been getting behind in the general competition for steel and pig iron, chief bottlenecks of new car construction, according to ODT authorities. Car deliveries shrank monthly after August of last year from 5,100 to 2,300 in February. The current junking rate of about 5,600 per month explains the present concentration on means to increase production.

A few weeks ago, freight car orders totaled about 91,000. Projected shipping schedules for this year amount to a minimum of 97,000, subject to later revision. The outlook is for a sharp drop in January, 1948, by which time normal requirements should be met.

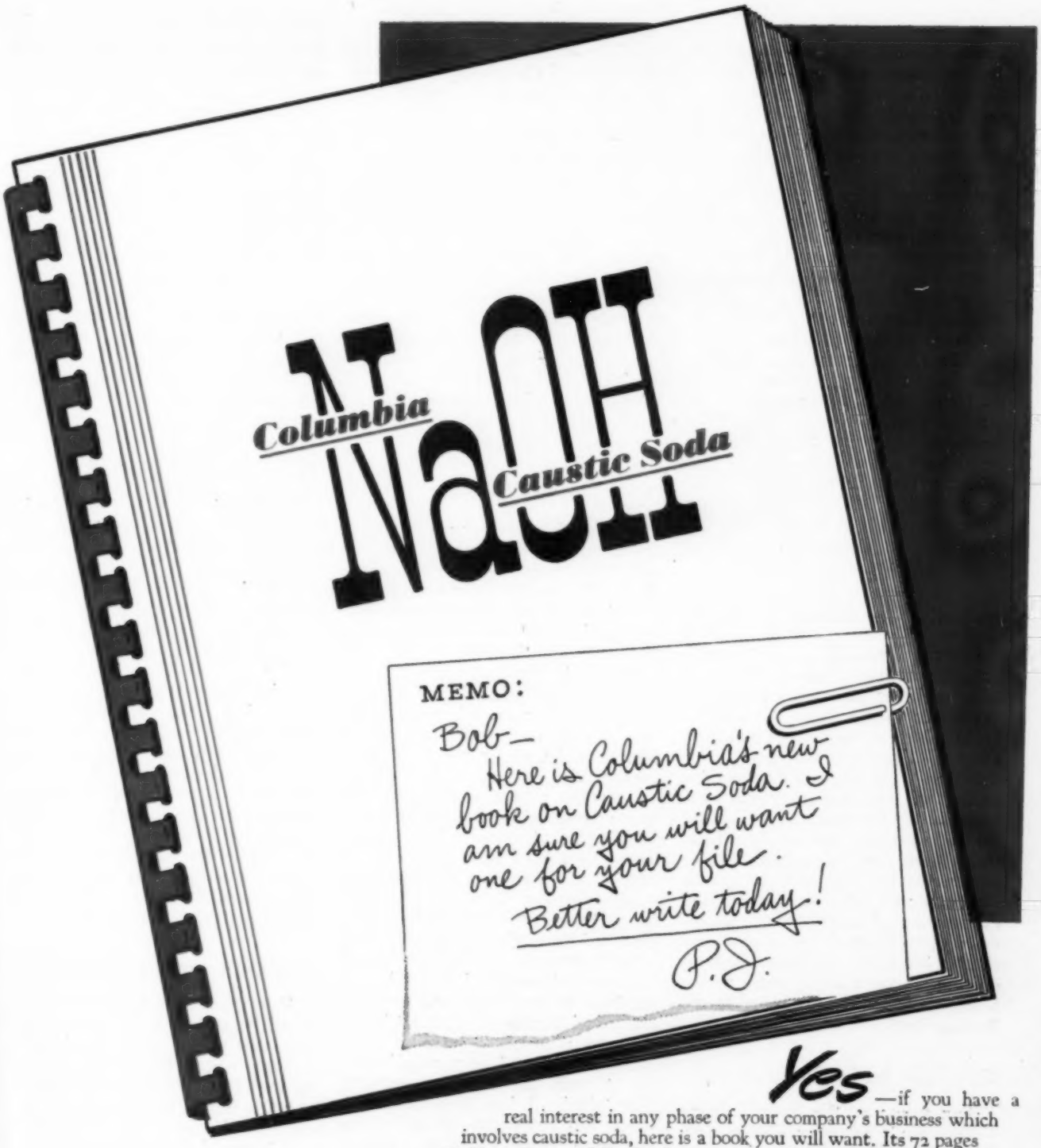
New Industry Reports

COMMODITY divisions of the Department of Commerce are to issue their "Industry Reports" in a new form from now on. These will continue to summarize information regarding supply, demand, and price trends, imports and exports, and other trade factors affecting the commodities. All of the new reports will be distributed by sale through the Superintendent of Documents, not by free distribution from the Department as heretofore.

The eight reports first scheduled include three monthly (chemicals and drugs at $2.50, leather at 60 c., and pulp and paper at $2.25 per year); two bi-monthly (fats and oils at $1; and canned fruits and vegetables at $1 per year); three quarterly (sugar, molasses, and confectionery at 50c.; coffee, tea, and spices at 40c.; and lumber at 50c. per year).

FTC Attacks Mergers Again

THE Federal Trade Commission is trying once more to secure legislation which would give it authority to prevent mergers by acquisition of assets. Last month the Commission filed with Congress a long report on recent mergers, listing wartime amalgamations and concluding that unless the transfer of assets from one company to another is made subject to FPC review and approval, the Commission's efforts to cope with industrial concen-



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tration through its veto power over stock purchases will continue to be nullified.

FTC's report was timed to support two measures, one in the Senate by O'Mahoney and one in the House by Kefauver. These measures would prevent purchase of assets of one corporation by another unless it can be shown that economies will result and that competition will not be lessened. If adopted, such legislation would end the present ability of a corporation obtaining stock of another to acquire the assets of the other even if PFC should move against the stock transfer.

Kefauver's bill got the blessing of the House Judiciary Committee at the previous session but was snarled in the Rules Committee. "Economic concentration" got a heavy play in the 79th Congress, and the President has recommended action of the type wanted by FPC. It is believed, however, such legislation is unlikely to reach the White House this year.

D. J. Centers Merger Work

In a neck-and-neck race last month with the Federal Trade Commission to get a firmer grip on merger movements, the Justice Department established a Merger Unit in the Antitrust Division. Justice officials look for a continuation of the trend toward industrial amalgamation that was accelerated during the war. Some of the Antitrust Division workers have been shifted into the new unit in order to concentrate upon its tasks. Function of the Merger Unit is to speed the examination of facts bearing on proposed mergers and acquisitions and shorten the time required to reach an opinion as to whether such moves would be regarded as contrary to the antitrust laws.

Gas Fight on in Congress

The future of the Federal Power Commission's authority over production, transmission and use of natural gas is being fought out this month in Washington. In the center of the melee are identical bills in the Senate and House which are intended to define beyond any further question the limits of FPC's powers in this controversial field. Committee rooms have been crowded with representatives of the petroleum and natural gas industries, railroads, coal mining, industrial fuel consumers, government agencies and others who would be affected by the passage of such legislation.

The bills in Congress are intended (1) to prevent FPC from controlling, directly or indirectly, the "end-use" of natural gas, (2) to prevent FPC from taking jurisdiction by any means over direct sales, (3) to prevent FPC from exercising authority over gathering activities or sales, or over activities of local distributing companies, (4) to require the Commission to speed action on applications for Certificates of Convenience and Necessity, (5) to require that agency to allocate costs "more equitably" between jurisdictional and non-jurisdictional classes of properties, revenues and expenses in regulating rates, and (6) eliminate the present compulsory "original cost depreciated" basis in rate making and substitute the field price method in determining operating costs for rate base purposes.

New Aromatic Sources

Toluol from petroleum is now a regular item in the market. Industry spokesmen guess that it makes up about 15 percent of the current supply. As yet it appears that comparable supply of benzol has not begun; but it threatens, so they say.

After V-J day toluol was selling for about 27 c. per gal. The price broke sharply, as was expected, when Uncle Sam sold about 11 million gallons of surplus at 10 c. per gal. f.o.b. storage locations. But that sudden dumping on the market represented less than a quarter of the demand of industry bidders. And apparently surplus stocks have been fully consumed or distributed. Prices which fell to the neighborhood of 20 c. have resumed their climb, advancing further during late March to approximately 24 c.

In former years coke-oven benzol far exceeded industrial demands and the bulk of the supply was used for motor-fuel blending. At present barely a quarter is so used, according to industry estimates. The price of benzol has strengthened recently even more than toluol. A few cents further advance will bring this chemical into the price range where recovery of benzol from aviation gasoline becomes profitable.

Voluntary Controls

Phenolic resin compounds will be distributed under voluntary allocation plans of resin producers expected to insure adequate supply for manufacture of scarce electrical wiring devices. On the basis of this assurance CPA announced ending of official control on March 31.

Supply of phenolic resin for other purposes is not expected to meet industry demands. Last month CPA said: "Products which can be manufactured only in proportion to the amount of phenolic resin available include automobiles, refrigerators, electric washing machines, electric household appliances, various types of industrial production machinery, and many other essential items."

It estimates, on the basis of producers' forecast, the availability in 1947 of 153 million pounds of molding powder approximately a 10-percent increase over 1946. However, much more could be produced if raw materials were available. But, it is officially stated "the outlook for more raw materials for the industry in 1947 has not improved."

Mines Director Named

On April 1 Dr. James Boyd who has been serving as dean of men at Colorado School of Mines assumed the directorship of the U. S. Bureau of Mines. He succeeds Dr. R. R. Sayers who has returned to his position as a member of the commissioned officer research staff of the U. S. Public Health Service. Dean Boyd, a geologist by training, gave several years service during the war period to strategic mineral supply, including service as assistant to Under Secretary of War. Later he assisted General Lucius Clay one industrial problem of the German occupied areas. The wartime service, during which he became closely associated with Secretary Krug on industrial mineral supply, is reported to be the basis of the present selection for this important Interior post.

Engineers for Ball Bill

One segment of Senator Ball's proposed amendments to the Wagner Act, that section which would assure separate status for professional employees in bargaining with management, is backed by six engineering societies. Testifying last month before the Senate Labor Committee, these groups supported those provisions of the Ball bill which would assure professionals and "junior" professionals the privilege of forming their own bargaining units, choosing their bargaining agents, separating themselves from non-professionals and refusing union membership without jeopardizing their positions.

Speaking for the engineering societies was E. L. Chandler, eastern representative of the American Society of Civil Engineers. Chandler pointed out to the committee that the engineering groups have tried "with re-

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CLEVELAND
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Speed Reducers

grettably little success to chart courses of conduct which will permit such employees to enjoy the opportunities apparently intended under provisions of the Wagner Act and to avoid pitfalls into which, from time to time, they have fallen to their detriment."

Groups backing Chandler's views are: American Society of Civil Engineers; American Society of Chemical Engineers; American Society of Electrical Engineers; American Society of Engineering Education; American Society of Mechanical Engineers; and National Society of Professional Engineers.

Water Concerns Industry

WATER supply is a serious industrial concern in many sections of the country, according to new information being compiled by the U. S. Geological Survey. On the basis of its studies the Geological Survey is working with industrial groups and state and local governments in an effort to stretch existing water supplies and minimize pollution.

A sharp rise in the use of groundwater for industrial purposes has been developing. Demand for this water has risen from two billion gallons per day in 1938 to 5.5 billion gallons in 1945. Expansion in requirements by large consumers like chemical plants, petroleum refineries, paper mills, food processing plants, distillers and metal working plants is reported as reducing groundwater levels to dangerously low points in many localities. Some seaboard regions face the threat of infiltration of salt water into the underground strata.

Pollution of surface waters is likewise presenting costly problems to users of those waters and is responsible for stream pollution bills introduced again this year in Congress. Some of the industrial states, hoping to avoid federal intervention, are reported taking strong measures against pollution. Pennsylvania, Illinois and West Virginia are vigorously attacking this problem. A recent investigation indicates that during the period of 1938-1946 the number of plants for treating industrial wastes has increased from 771 to 1,114.

Paper Men Face Lean Year

PAPER industry authorities in the Department of Commerce point to several difficult problems likely to hamper the production of pulp and paper during most of this year. These problems extend beyond the long-standing shortages of basic chemicals required in paper making. They go back to the pulp wood forests of this country and its foreign suppliers.

The supply of mechanical equipment of practically all types to bring to the mills the pulp wood in the United States and abroad is far less than requirements. One of the worst shortages in equipment is that of freight cars, a shortage expected to continue much of this year.

With respect to imported wood pulp, 63 percent last January came from Canada, which increased its shipments steadily throughout 1946. However, it is believed that any further gains in this movement must depend heavily on deliveries of scarce machinery to Canada. As to imports of pulp from the northern European countries, Commerce Department officials say domestic paper manufacturers doubt that the supply in 1947 from those countries will surpass 600,000 tons, a predicted inadequate fuel supply being responsible for this low figure. Some non-integrated paper mills are operating on a 5-day week because of shortage of pulp.

Allocations End

NEITHER potash nor phosphate will be subject to allocation after the end of this fertilizer year. This decision comes from both domestic authority at Washington and the international group which has guided world trade in these materials through International Emergency Food Council, and its predecessor Joint Food Board. But nitrogen controls certainly will continue unless a Republican Congress intervenes to change the plans of the executive departments which continue to support IEFC in its nitrogen planning.

Mineral Advisers for Krug

FORMATION of a minerals industry advisory committee for the Interior Department along lines similar to those of the National Petroleum Council is expected some time this year. Late in March, nine men from the mining industry met in Washington to discuss the matter with Secretary Krug, who had asked the industry last fall to draft a special group to help him create such a committee.

The nine-man group has offered three major suggestions: (1) That selection of committee members be put in the hands of the industry, with Krug asking for nominations; (2) that a separate advisory committee be established for coal; (3) that the projected minerals committee be limited to about 30 men so chosen as to be representative of a wide range of the field. Secretary Krug is expected to go slowly and carefully in the matter, in view of the sharp scrutiny which the Justice Department maintains on industry advisory committees.

Minor News Glimpses

Naval stores can be produced at much lower cost, according to U. S. Forest Service, if using the "Modern Turpentining Practices" described in Farmers Bulletin No. 1984 issued by the Department of Agriculture. A major improvement is a method of acid spraying which maintains gum flow from cut faces for at least three times as long without re-chipping.

Fats and oils data may be less readily available from the Census Bureau if present economy plans prevail. Almost complete discontinuance of some of the important reports is contemplated unless Congress provides more money. Possibly offsetting this curtailment is the effort of Shortenings Institute which wants the present optional Census inquiries to be made mandatory by Congress.

Imports from Germany and Japan are being sold by the government through U. S. Commercial Co., an agency of RFC. This means is used to control first American distribution of goods which Armies of Occupation gather in their areas in order to build up dollar credits with which to buy goods from the United States.

Accord on German patents, arranged last summer, has come into force and has been ratified by 28 countries. Effect of the agreement is to make available to nationals of all participating countries non-exclusive rights to use, without payment of royalties, all former wholly German-owned patents issued by those countries, subject to protection of existing rights lawfully acquired by non-Germans.

A fractionating column of exceptionally high efficiency has been developed at the Bureau of Standards in connection with the research program on hydrocarbons sponsored by the Bureau and American Petroleum Institute. High diffusion rates of gaseous molecules is secured by forcing the vapors into turbulence as they pass through an annular space between a fixed outer column and a rapidly rotating closed inner cylinder.

CHEMICAL ENGINEERING
with CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902 APRIL 1947 SIDNEY D. KIRKPATRICK, Editor

Continuing and Continuous

LAST month in Painesville, Ohio, we re-visited one of the world's most interesting plants—the first in the viscose rayon industry to apply continuous processing in successful large-scale operations. Here engineering ingenuity compressed into six minutes all the operations from spinneret to the dried and twisted yarn—a cycle which in other viscose plants of its day required ninety hours. In the ten years since the process was installed, there has been continuing progress. Operations are almost completely automatic, maintenance in surprisingly low, and quality uniformly high. The company's accident frequency rate last year of 4.8 percent, as compared with 14.0 percent for all industry, brings it this year's Distinguished Service to Safety award of the National Safety Council. And 1946 also brought to the stockholders of Industrial Rayon some of the financial benefits they had a right to expect from the development of this outstanding chemical engineering process.

While we were in northern Ohio, one of our editorial consultants was in Cincinnati putting the finishing touches on an article and flowsheet that feature this issue of *Chemical Engineering*. Here again is the story of more than a decade of continuing progress in applying continuous processing to one of the oldest of our chemical industries—soap making. That the chemical engineers of Procter & Gamble should have accomplished this important advance is greatly to their credit. That the management of this progressive enterprise was willing to invest so heavily in research, development and extraordinarily expensive plant construction is also to their credit. Together, they have proved for all time that soap making is no longer a tradition-bound, rule-of-thumb industry where progress was possible only by building bigger kettles to tie up more and more materials in process. Operations that once required from two weeks to a month are now done in a matter of hours. Greater flexibility, more accurate control of both quality and quantity of production and more efficient use of manpower are again among the benefits of continuous processing.

Now, more than ever before, there is urgent need for these chemical engineering achievements in other batch-operated industries. The cost of a manhour has reached an alarmingly high level. In the case of our rayon plant, labor costs since 1941 have risen by 75 percent and we must face the fact that manhours will probably be even more costly as time goes on. But if living standards are going to be raised, those manhours must become more and more productive. And that is where the chemical engineers can contribute most with their improved processes and equipment.

Some day in the not too distant future the progressiveness of an industry is going to be gaged by the effectiveness of its use of labor. We should all give greater study to the ratio between the value of goods produced (or their tonnage) and the number of manhours required as direct labor in their production. As the cost of the manhour goes up, it is our responsibility to see that output is increased both in quantity and in value. Otherwise, our industries will fall behind others in their economic and social status.

Continuing progress depends upon greater production, lower costs and higher efficiency. Continuous processes can help other industries besides rayon and soap in attaining these worth-while objectives.

Here continuous process converts raw materials into finished products in space of operating day in contrast to former methods requiring long periods of processing and hardening of the soap

CONTINUOUS PROCESS FOR SOAP

GORDON W. McBRIDE
Editorial Consultant, Chemical Engineering, Washington, D. C.

CONTINUOUS OPERATION FROM RAW MATERIALS TO FINISHED PRODUCT MAKES MODERN SOAPMAKING A CHEMICAL ENGINEERING ACHIEVEMENT

CHEMICAL ENGINEERING — "99-44/100% pure"—has triumphed in one of the world's oldest process industries. For centuries soap has been made by reaction of fat and lye. Until recently, most improvements in the manufacturing process have been merely increased size of equipment or better control devices, but no radical change had been made in the fundamental soap kettle. It has remained for modern chemical engineers to eliminate the traditional boiling of soap and to substitute engineering control for essentially rule-of-thumb methods.

Soap is now being made, from raw fats to finished product, in a matter of hours instead of the many days formerly required. This process as developed by the Procter and Gamble Co. is continuous countercurrent hydrolysis under pressure and at high temperature with a catalyst,[1] followed by continuous distillation, neutralization, and finishing. The mixture of fats, in the proper proportions for whatever soap is being made, reacts with water to split into fatty acid and glycerin. The fatty acid is purified by distillation and then is neutralized. The resulting "neat soap" may be finished into any of the usual products. The byproduct glycerin is concentrated in a multiple-effect evaporator which is synchronized with the fatty acid production.

Largest single dollar advantage in the process is in the improved color of soap resulting from a crude fat, or ability to produce a desired color of soap from a darker crude fat without extensive pretreatment. Improved glycerin recovery is also a significant advantage, and flexibility in control of chemical and physical properties of the finished soap offers further dividends. Space requirements for one of these modern soap plants can be re-

Soapmaking by a continuous process has lifted that industrial activity into the front rank of modern chemical engineering. The "P & G" method here described has, besides the usual advantages of continuous processing, time saving, space saving, improved color of soap, improved glycerin recovery, increased flexibility of operation, and reduced quantity of materials tied up in process. The author writes from first-hand knowledge, as he participated in developing the process and in starting up the first commercial unit.

duced considerably when compared with the traditional kettle plant; and manpower required to operate the modern plant is also less. The usual advantages of a continuous process are also attained, particularly in flexibility of operation and greatly reduced quantity of materials tied up in the process at any one time.

The continuous soapmaking process was developed during the last decade, the engineers working on its component operations one at a time. When satisfied with each operation on a pilot-plant scale, the coordination of production-size units was begun. Although the development work was done at the principal factory of the company at Cincinnati, the first complete unit was erected at Chicago, where production started in the summer of 1938. Shortly thereafter other units were assembled and continuous operation is now standard practice at many of the company's factories, producing all types of soap. At some of the plants the process was added to existing soap departments; but at others these new units represent the only soap production equipment required.

Home factory of Procter & Gamble at Ivorydale, Ohio, location of Chemical and Engineering Divisions where continuous soap process was developed

Processing

Raw fats and oils in the proper proportions for a given soap formula are pumped from storage tanks into a blend tank located on an upper level. The blend tank holds about a six-hour supply of fat and is provided with steam coils for preheating and a propeller-type mixer for stirring in the dry catalyst, zinc oxide. The catalyst dissolves in the fat by reacting with the small amount of fatty acid normally present in raw fats to form a zinc soap, and it is in this form that it promotes the reaction. The fat mixture is maintained at a temperature of 220 deg. F. in the feed tank. A water feed tank at the same level is of comparable capacity and the water temperature is held at 200 deg. F.

The fat mixture and the water are put under high pressure by triplex piston feed pumps. The pumps are driven by variable speed drives so that the rates and proportions of fat to water may be accurately controlled. When under pressure, the fat and water are heated to hydrolysis temperature by direct injection of 900-lb. steam.[8] The water is heated to 480 deg. F. and the fats to 495 deg. F. before entering the hydrolyzer column at 600 lb. per sq. in.

Fats are pumped into the column near the bottom and the water near the top, so that countercurrent flow of water downward through rising fatty material is obtained. The column is operated with a "seat" of water at the bottom, thus keeping the vessel principally filled with fats and fatty acids. No baffles, trays, or packing material of any kind are required inside the column.

The advantage to be gained by high temperature, countercurrent operation can be understood when one considers the chemical reaction involved.

$$(RCOO)_3C_3H_5 + 3\ HOH \rightleftarrows 3\ RCOOH + C_3H_5(OH)_3$$

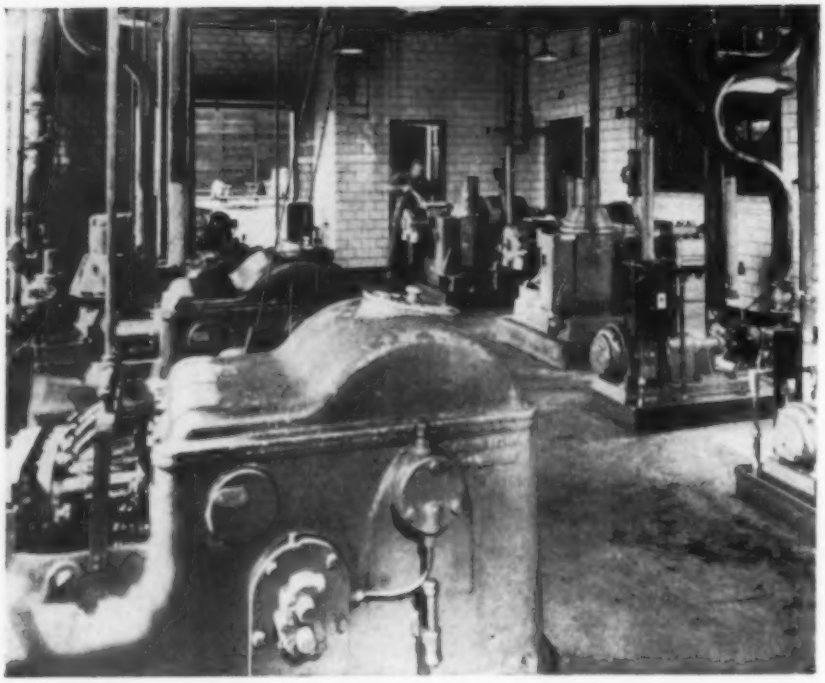
This reaction is reversible so that in order to make it proceed to the right it is necessary to remove the glycerin as it is formed. This is accomplished by the countercurrent washing action of the water. The fresh water entering the top of the column reduces the glycerin content to the lowest possible point, while at the bottom of the column the "sweet water" has the highest glycerin content as it leaves the column.

High temperature is important because physical contact alone between a fat phase and water droplets is inadequate to achieve an economical rate of reaction. The high temperature makes it possible to dissolve a considerable quantity of water in the fat phase. At room temperature, for example, the commonly used soap fats dissolve only about 0.1 percent of water. At 300 deg. F. this percentage has risen to 3 to 6 percent, depending upon the fats, and at 480 deg. F. the solubility is on the order of 12 to 25 percent.

High Temperature Helps

Obviously the intimate contact of water molecules with fat molecules and their potential reactivity are enormously increased when considerable portions of water are actually dissolved and distributed throughout the entire mass of fat. High-temperature conditions make this possible, and the interchange of water and glycerin between the fat phase and water droplets proceeds rapidly to extract the glycerin from the fat phase as it is formed.

Fatty material passes upward



General view of pump room showing neutralizer pumps in foreground, still and hydrolyzer pumps at right and right rear

through the column in about 90 minutes during which time splitting of the fat into fatty acid is about 99 percent complete. The fatty acids at exit, saturated with water, discharge through an orifice into a flash tank. The dissolved water vaporizes, cooling the fatty acids and blanketing them with steam which protects them from darkening by exposure to air.

Glycerin Concentration

Glycerin concentration at the bottom of the column can be varied by changing the ratio of water to fats pumped into the column. However, a more concentrated glycerin may be obtained only by sacrificing high "completeness" of splitting the fats or high production rate. Once the column size has been chosen, operating rates determine the balance between completeness and glycerin concentrations coming out of the hydrolyzer.

Reducing the pressure on the glycerin solution as it comes out of the bottom of the column into a flash tank accomplishes the first concentration of this glycerin. The steam which flashes out of the solution and the more concentrated glycerin which results continue through a multiple-effect evaporator of which the flash tank may be considered the first effect. Since there is no salt in the sweet water the conventional salt-evaporator normally found in a soap plant is not required. For the same reason a better than average quality of crude glycerin is recovered from the new process.

Carrying out a chemical reaction on a continuous basis and at this temperature, when fatty acid is one of the reagents involved, was not practical until stainless steels were available as a material of construction and modern welding techniques were developed for high-pressure equipment. In general the equipment throughout the process is made of stainless steel where the fatty acids are at high pressure or temperature but of aluminum where at low pressure.

The hydrolyzer is a stainless steel column 65 ft. high. The column is provided with electrical heaters to bring it up to temperature when starting operations and with insulation to maintain reaction temperature at any time that a temporary shutdown is necessary. The column is protected from excessive pressure by a rupture disk from which the vent line goes to a flash tank. The contents of the hydrolyzer, in case this disk should break, would be discharged into the flash tank and the steam would flash out through a suitable vent. The column is outdoors beside the main building, but indoor connections are provided for convenient control at the second floor level. The pipelines from the column into the building are protected with automatic pressure check valves so that in case of mechanical failure within the building, the column could not empty its contents into the operating room.

Fatty acid to be distilled collects in a still feed tank. It is then pumped through a heat exchanger and into the vacuum still.[4, 5] Distillation of the fatty acid is carried out at an absolute pressure of 2 to 5 mm. of mercury. Still bottoms are circulated back into the still feed for two reasons: (1) To remove distillable fatty acid from the bottoms, and (2) to act as a "heat carrier" making it possible to keep the temperature of the fatty acids lower than would otherwise be possible. If fatty acids were distilled without recirculation, the temperature required would be about 575 deg. F. Using the recirculation principle, the fatty acid-bottoms mixture goes to the still at 460 deg. F. and accomplishes the same distillation. Immediately upon entering the still, the distillable fatty acid is volatilized, whereupon the liquid remaining behind is cooled to 400 deg. F.

Fatty Acid Distillation

Fatty acid enters the still in a unique manner. The boiling mass rushes upward through a "vomit tube" and impinges against a metal umbrella which deflects the unvaporized liquid material downward and outward. This forms a continuous curtain of liquid between the edge of the umbrella and the still body. This liquid curtain stops entrainment, since any small droplets of liquid are trapped by the curtain and carried along with it. Of course, the vapor space is made large to reduce vapor velocities at the low absolute pressure. The distilled fatty acid is condensed and goes to a distillate receiver at about 300 deg. F. Circulation of the distillate over cooling coils reduces its temperature to about 180 deg. F. This fatty acid is withdrawn from the receiver to be used in soapmaking. Bottoms from the still amount to 5 to 15 percent of the still feed. They are pumped to storage for subsequent treatment and recovery of the remaining fatty acids.

Fatty acid is neutralized by mixing with a proportioned quantity of caustic soda solution in a high-speed mixer. When desired, the soap may be made just as easily using mixed lyes such as mixtures of KOH and NaOH in order to improve solubility properties of the soap. Piston type proportioning pumps are used to feed both caustic and fatty acid into the mixer, both pumps being driven by the same drive with a variable speed adjustment between the two for small adjustments in proportions. The moisture content of the resulting soap is predetermined by making up the proper caustic concentration. Salt is added to the caustic soda to secure a

esses, amine hydrochlorides may be used as catalysts. In the alternative process, aqueous hydrochloric acid is mixed with the tetrahydrofuran and the reaction carried out in pressure-tight equipment at a temperature of approximately 180 deg. C., and pressure of 250 psi. All three processes involve serious corrosion problems but, fortunately, glass-lined equipment and accessories are available that will adequately resist effects of aqueous HCl.

Step IV is the reaction of dichlorobutane with sodium cyanide whereby the two Cl atoms are replaced by CN groups to yield the desired adiponitrile. This process is also carried out in the presence of a solvent which removes the adiponitrile from the NaCl and other reaction products. A final distillation yields ADN as a non-corrosive liquid of high purity.

As is also indicated in the accompanying chart of chemical reactions, adiponitrile can readily be hydrogenated to produce hexamethylene diamine, or if so desired, it could be hydrolyzed to adipic acid. Thus both components of Dr. Carothers' "66" synthesis of the nylon superpolymer of hexamethylenediammonium adipate could be made entirely from furfural. There are several reasons why only the hexamethylene diamine will be made from this source, at least at this time.

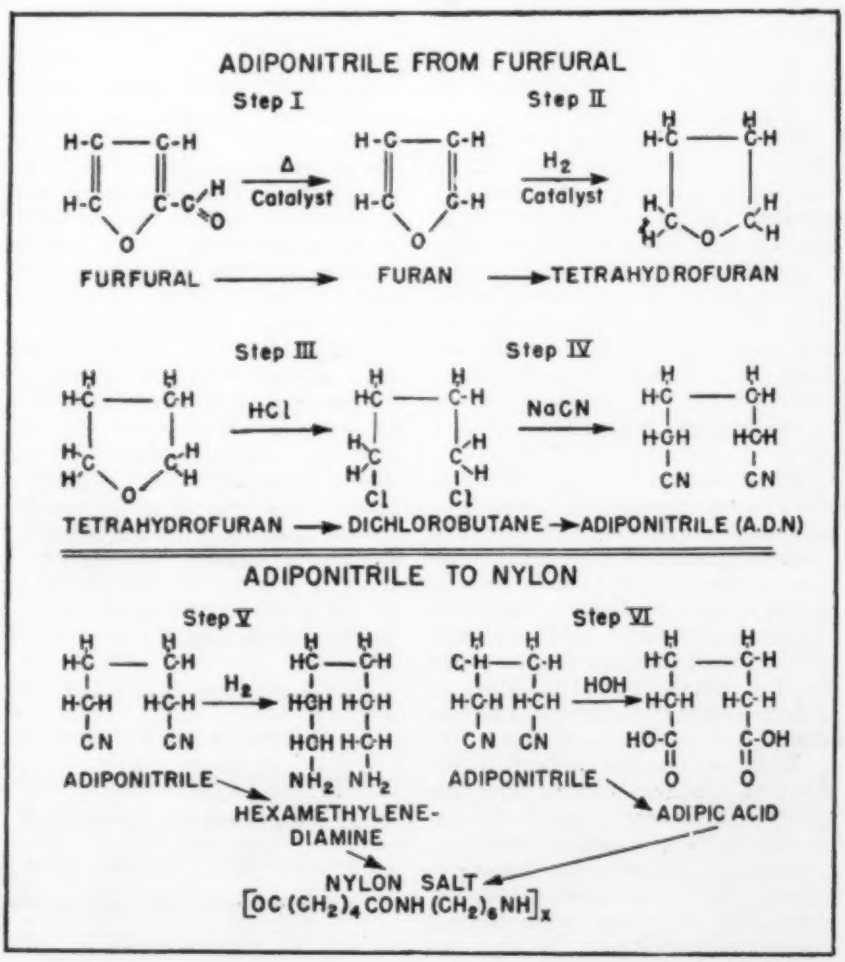
In the present "standard" process, the synthesis begins with benzene, which is converted to adipic acid, and adipic acid is then reacted with ammonia to produce adiponitrile which is hydrogenated to yield hexamethylene diamine. The furfural route thus has the advantage of by-passing the adipic-acid step in the production of hexamethylene diamine. By the same token, however, there is less advantage in producing adipic acid from furfural since it adds the adiponitrile step not now required in the standard process.

No estimate is available as to the savings that can be effected by the furfural synthesis. Since they affect only one of the nylon ingredients and involve further large-scale development of a research project which has already cost approximately $1,000,000, it is not likely that the use of agricultural byproducts can materially reduce the manufacturing cost of nylon within the near future. However, it should prove a helpful step in the normal du Pont process of reducing prices to the consumer as advances are made in research and volume production. Readers need scarcely be reminded of the history of cellophane prices nor that nylon yarn itself has been reduced from $3.52 to $2.15 per lb. since the popular hosiery yarn was introduced in January 1940. (Prices quoted are for the 40-denier, 13-filament, semi-dull hosiery yarn.)

But, from the broader viewpoint of science and industry, the achievement of the researchers in the Electrochemicals Department, takes on many other interesting possibilities. It is obvious from the reactions involved in the adiponitrile synthesis that many new and valuable furan derivatives in addition to tetrahydrofuran and 1,4-dichlorobutane can be drawn off as side streams from the main synthesis. Furthermore, the use of the sodium cyanide method becomes an effective means of building up hydrocarbons to almost any desired number of carbon atoms—particularly in the important C_5 to C_8 range. And, finally, furfural comes into its own as a comparatively cheap and pure raw material for an expanding field of industrial processes.

This transmutation of the lowly corncob into one of milady's most cherished possessions is the perfect example of chemurgy—of chemical science at work in converting agricultural "wastes" into useful products for society. Corncobs are essentially a waste product with little more than "nuisance" value to the farmer. According to E. D. Funk, Jr., of Bloomington, Ill., the U. S. total corncob crop is about 16 million tons. The Northern Regional Research Laboratory of the U. S. Department of Agriculture points out that within a 50-mile radius in Illinois or Iowa, one can obtain enough corncobs to produce 10 million pounds of furfural. When the Quaker Oats' wartime subsidiary, The Q. O. Chemical Co. began to operate the Defense Plant Corp. furfural plant in Memphis, Tenn. (see *Chem. & Met.*, pp. 132-135, July 1945), the principal raw material up to that time had been ground oat hulls. With a growing demand in stock feed, that supply was soon exhausted and the new plant now operates on cottonseed hulls and rice hulls, supplemented by the use of corncobs.

Furfural itself is the almost perfect chemurgic product. When first produced 25 years ago by the Miner Laboratories, the price was around $2.50 per lb. In a short while it was down to $1 and in 1926 to 15c. Then came large-scale uses in the synthesis of resins, in the refining of lubricating oils, wood rosin and vegetable oils, and in the refining of butadiene for synthetic rubber. The current market is about 50,000,000 lb. furfural per year and the price in tank cars is 9½c. per lb.



NEW PROCESS FOR ACRYLIC RESINS

RICHARD W. PORTER
Assistant Editor, *Chemical Engineering*

A NEW PROCESS HAS BEEN DEVELOPED FOR MANUFACTURE OF METHYL METHACRYLATE MONOMER, MOLDING POWDER AND TRANSPARENT SHEET

Keyed to the aviation industry, methyl methacrylate production soared during the war to provide the transparent plastic used in bombers and other military aircraft. However, even with aircraft manufacture now at a virtual standstill, this war-built capacity has failed to meet peacetime consumption requirements. Now, the availability of a new low cost process could well help this industry to fill unsatisfied demands.

This process, developed by A. Brothman & Associates, New York, N. Y., consists of an entirely new monomer synthesis and polymerization method. Based on acetylene and acetone rather than hydrocyanic acid and acetone, the new synthesis promises sharp reduction in production costs due to the inherently high production yields and lower total raw materials cost.

Designed to Specifications

Resulting from research started in 1943 for an agency of the Chinese government, this was only one of several projects contracted for by this company to provide China with an integrated chemical industry dependent only on raw materials readily available to that country. These include plants for the manufacture of calcium carbide, acetone, formaldehyde, and urea and phenol formaldehyde resins.

Basic specifications outlined by the Chinese contract required that the methacrylate process must (1) not conflict with any existing patents or processes, (2) demonstrate cost of production figures to match or improve upon the best and most efficient American practice, and (3) result in a high grade optical sheet meeting U. S. Army-Navy specifications.

Not only were these requirements fulfilled but they were exceeded. This new monomer synthesis is distinctly different from that employed in any other process. Production costs, estimated for plant scale operation and based on laboratory and pilot plant work, are considerably lower than those indicated by present market prices. Furthermore, the monomer process can be switched readily from production of methacrylate to turn out valuable intermediates and chemicals such as are shown on the reaction chart. These include methyl butinol, methyl isobutanolone and methyl methacrylatone, as well as salts and esters of alpha-hydroxy isobutyric acid.

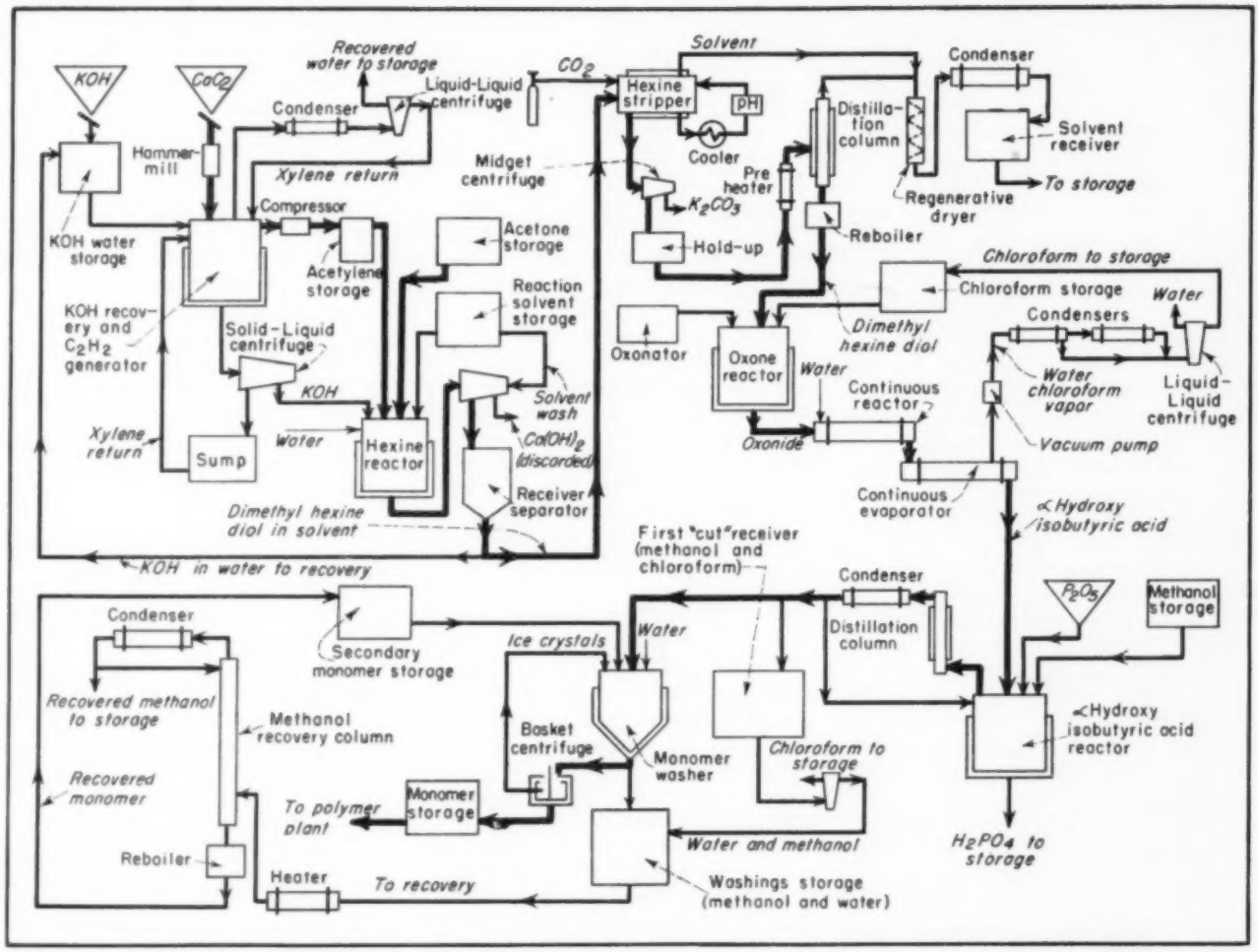
The polymer sheet process, employing a unique combination of catalysts, has reduced the polymerization cycle to nearly ¼ that required by other methods. Abrasion resistance and flexural deformation temperature characteristics, as well as tensile strength and elongation properties exceed specifications. These advantages result from using a mixture of catalysts which permit close control of the rate of polymerization and mean molecular weights. Resulting from a thorough analysis of the mechanics and kinetics of polymerization, the principles of this process have been applied successfully to the polymerization of styrene to optical grade polystyrene and to the production of methyl methacrylate molding powders.

Based on laboratory and pilot plant data the Brothman organization has now completed engineering and design of a commercial methyl methacrylate plant for production of (1) liquid monomer, (2) high grade optical sheet polymer, and (3) polymer molding powder.

Integrated Plant

The plant is designed to operate on a 24 hour per day basis but the processes and various operations, which are both batch and continuous, are so integrated that practically any operating schedule can be maintained. Actually, the initial batch reaction sets the pace for the monomer process. Successive units of the process operate in intermittent cycles so arranged as to obtain maximum production. Polymerization to form sheets consists of a series of batch type opera-

Originally developed for the Chinese government the Brothman process is based on new techniques and new reactions for producing methyl methacrylate resins. Sheets of the clear transparent plastic, polymerized by using a unique combination of catalysts, have shown by means of standard tests to possess good qualities. Processes described in this article are fully protected by patents.



Flowsheet for methyl methacrylate monomer production. Heavy line indicates flow of main reaction products

tions while the molding powder process is strictly continuous.

Based on an operating schedule of 25 days per month and 24 hours per day, a plant designed for monthly production of 750,000 lb. of monomer, 250,000 lb. of polymer molding powder, and 500,000 lb. of transparent polymer sheet can be built under current conditions at an estimated total cost of $300,000.

Reactors, heat exchangers and other process equipment are predominantly made of stainless steel to prevent contamination of the product. Most of the equipment is of conventional design which makes for easy maintenance and lower plant costs. Operations throughout the whole process are designed for complete automatic control which provides maximum efficiency with a minimum number of operators.

Monomer Synthesis

The monomer synthesis consists of three essential steps, namely: (1) synthesis of dimethyl hexine diol from acetylene, acetylene derivatives, and acetone, (2) an ozone catalyzed oxidation-splitting of the dimethyl hexine diol to alpha-hydroxy isobutyric acid and (3) combined esterification and dehydration of alpha-hydroxy isobutyric acid with phosphorus pentoxide and methanol to form methyl methacrylate monomer. The process is carried out by mixed batch and continuous operations.

Basic raw materials are calcium carbide, acetone and methanol. Other materials include potassium hydroxide, phosphorus pentoxide, carbon dioxide and solvents including chloroform and xylene. Potassium hydroxide and the various solvents are recovered and reused with negligible makeup.

Acetone, acetylene and potassium derivatives of acetylene are reacted in a batch process in the presence of a catalyst, KOH, in a solvent to form the dipotassium alcoholate of dimethyl hexine diol which is subsequently decomposed by hydrolysis to yield dimethyl hexine diol.

Dehydrated solid catalyst mixture from the KOH recovery and "conditioning" system is charged to the agitated refrigerated reactor where it is dissolved and suspended in a special reaction solvent selected because of its high solubility for both KOH and acetylene. Temperature is dropped to 15 deg. C. and the acetylene resulting from the KOH "conditioning" operation is bubbled into the kettle where its dissolution in the solvent is aided by a gas-liquid mixer. When acetylene-solvent equilibrium is attained, as indicated by a pressure gage on the kettle cover, acetone is added in the ratio of 2 mols to 1.2 of acetylene at a rate consistent with the ability of the cooling system to maintain the exothermic reaction at a temperature not exceeding 15 deg. C.

After the reactants have been fully added the reaction is allowed to continue for 2½ to 3 hrs. to complete the formation of the alcoholate, a heavy viscous material. Temperature is then lowered to 5 deg. C. and water added to decompose the alcoholate to dimethyl hexine diol. Upon completion of hydrolysis the whole reaction mass is pumped to a continuous solid-liquid centrifuge to remove solid $Ca(OH)_2$ which entered the re-

actor with the catalyst mixture and remained as an inert impurity. Filtrate passes to intermediate storage where it separates into two layers. The bottom layer, a water solution of KOH, is run off to storage prior to recovery while the upper layer of dimethyl hexine diol and solvent, with a slight amount of water, passes to a continuous stripping and distillation system.

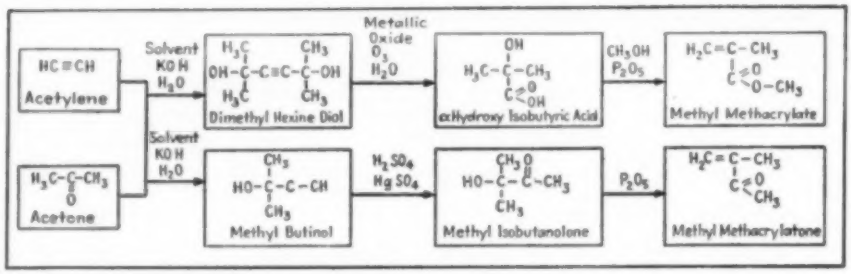
The KOH and water are separated and reused. KOH must be completely free from moisture both for maximum solubility in the reaction solvent and because it is used to absorb the water formed during the hexine reaction. A unique process for recovering dry KOH also involves the production of acetylene from calcium carbide. Water and KOH from the preceding batch, to which any necessary makeup is added, is run at a fixed rate into the recovery kettle containing a charge of xylene. Temperature is raised to 94 deg. C. and a combined xylene-water distillate is taken off, condensed and separated in a liquid-liquid centrifuge. Water is stored for subsequent reuse in the hexine decomposition reaction while the xylene phase is returned directly to the recovery reactor. This continues until the whole batch of KOH water solution has been charged to the reactor. Temperature is raised to 111 deg. C. and when equilibrium is established the condenser is cut out of the system leaving a prescribed amount of water.

Recovery of KOH

Calcium carbide in preset quantity is pulverized in a hammer mill and added to the vessel where it initiates a complex reaction equilibrium system to form acetylene, potassium carbide, and potassium hemiacetylide. The acetylene is compressed and stored for use in the dimethyl hexine diol reaction. When acetylene ceases to be formed it is an indication that the carbide-water reaction is complete and that the KOH-K_2C_2-KHC_2 equilibrium has been attained. This whole reaction is automatically controlled.

While one purpose of carbide addition is to dehydrate the KOH, the formation of K_2C_2 and KHC_2 at this stage cuts down the time required by the reaction to form the dipotassium alcoholate in the previously described reaction.

Contents of the recovery kettle, comprising the solids KOH, K_2C_2, KHC_2 and $Ca(OH)_2$ from the carbide-water reaction together with xylene and a small amount of reaction solvent which was present in the original



Reaction chart for methyl methacrylate and methyl methacrylatone

KOH-water solution, are fed to a solid-liquid centrifuge. Solids drop to a closed conveyor and are delivered to the hexine reactor. Filtrate is held in a sump and then returned to the recovery kettle where the lower boiling reaction solvent is separated from the xylene by a batch distillation and is returned to storage.

Hexine Purification

Isolation of dimethyl hexine diol from solvent and water is accomplished in a two stage system consisting of a continuous stripping action followed by continuous distillation to leave a residuum of high purity dimethyl hexine diol. Stripping takes places in a jacketed still pot at a controlled temperature of 60 deg. C. leaving a constant composition mixture in the still which is continuously drawn off to feed the subsequent distillation process. Distillate is dried by passing through a regenerative silicia gel dryer before being condensed and returned to solvent storage. Feed to the stripper is controlled by a temperature instrument on the still and discharge is regulated by a liquid level controller.

The pH is automatically controlled by continuously sampling the still bottoms and regulating the input of CO_2 which neutralizes KOH released by the stripping action to form the insoluble $KHCO_3$ and K_2CO_3. This prevents the alkaline decomposition of dimethyl hexine diol. CO_2 is used rather than a strong acid because both the product and reaction solvent are subject to acid decomposition. KOH is present at this stage because the hydrolysis of the alcoholate to dimethyl hexine diol does not go to completion until it reaches the temperature of the stripping still. When this occurs the KOH in the alcoholate is released and must be neutralized immediately by the CO_2.

After stripping, the mixture in the still containing dimethyl hexine diol, solvent, and water with small amounts of solid $KHCO_3$ and K_2CO_3 is run through a midget centrifuge to remove the precipitate while the filtrate passes to a small hold-up tank from which it is pumped, under fixed rate control, to the second distillation stage. Here, it is first preheated and then fed to the continuous distillation column where the solvent and most of the water are taken off. Vapor passes through the regenerative silica gel dryer to remove the moisture while the solvent is condensed and returned to storage. Bottoms in the reboiler portion of the still, comprising pure dimethyl hexine diol and some water, is continuously dissolved in a stream of chloroform to give a 10 percent solution by weight. The water is removed by passing through a regenerative dryer and the solution run to the oxidation reactor.

Oxidation

Here the dimethyl hexine diol is first converted to the ozonide which is then split with water to form alpha-hydroxy isobutyric acid. Oxidation is a batch process. Temperature of the hexine chloroform solution is lowered to 0 deg. C. before ozone in an air-stream is added at a rate which allows the reaction temperature to be maintained at 0 deg. C. Ozone acts as an associate catalyst to a metallic-oxide catalyst for the air oxidation-splitting of dimethyl hexine diol.

When ozone-air addition is completed the solution is pumped at a fixed rate to a continuous reactor where the ozonide is decomposed with water. The reactor is, in effect, nothing but a heat exchanger where the reaction temperature is held at 0 deg. C. Ozonide solution is mixed with a stream of water in the entry bonnet of the reactor and emerges as a two-phase system consisting of (1) chloroform and (2) water, with the acid distributed between both phases.

The reactor discharges to a continuous vacuum evaporator operating at a vacuum of 500 mm. of Hg and a temperature of 49 deg. C. where a partial steam distillation of the chloroform is accomplished by the water. During the passage of the material

through the evaporator, the water is completely driven off resulting in a 30 percent by weight solution of product in chloroform. Vapors pass through the vacuum pump and go to the condenser at a slight positive pressure. A two-stage condenser system is used. The first stage is cooled with water and the second is refrigerated to prevent loss of chloroform vapor in the air which leaks into the vacuum system. Condensate is run through a liquid-liquid centrifuge to separate the water and chloroform and the latter is stored and reused.

Conversion to Monomer

Conversion of alpha-hydroxy isobutyric acid to methyl methacrylate monomer is accomplished by the esterification and dehydration of the acid with methanol and phosphorus pentoxide. It is a batch process. To the moisture-free solution of acid in chloroform, P_2O_5 is added from a sealed hopper unit in the ratio of 1/3 mol per mol of alpha-hydroxy isobutyric acid. The solids addition line is closed off and the mass heated and refluxed for 3½ hrs. after which time all the solid P_2O_5 has been reacted. Methanol is then added (3 mols to 1 of acid) and refluxing is continued for 2 hrs. to complete the esterification and dehydration to form methyl methacrylate monomer. Phosphoric acid is formed as a byproduct and is drawn from the reactor after the monomer is distilled off.

After refluxing, the mass is subjected to a batch distillation in which the first "cut" taken off includes all of the chloroform with the bulk of the unreacted methanol as an azeotropic distillate. This is taken to a storage tank and the components subsequently separated in a centrifuge after a water scrubbing operation.

Freeze Out the Water

When the first "cut" has been taken off, the subsequent chloroform free distillate is sent to the distillate receiver and washer where, upon the addition of water, the monomer methacrylate settles out as an upper layer and the water methanol solution as a lower layer. This lower layer is run off to the monomer washings tank and the monomer subjected to three successive water washings. After this treatment the monomer is chilled by refrigeration to the point where mechanically entrained water and water of solution freeze to form crystals. This slurry of ice crystals in liquid monomer is passed to a basket centrifuge where the ice crystals are separated and returned to the receiver and washer to be reprocessed with the next batch of monomer. Filtrate from the centrifugal, consisting of pure, moisture-free methyl methacrylate monomer is stored under refrigeration until drawn off for polymerization.

Same Process—Other Products

Methyl butinol is produced from acetone and acetylene by a process closely resembling that for the production of dimethyl hexine diol. In this case the ratio of the acetone to acetylene and the reaction time are modified. The process is basically the same as the hexine reaction except that the process time is shortened to yield the butinol. KOH used is again recovered and conditioned in the manner previously described. The reaction mass is subjected to the same separation treatment as for the hexine. KOH is again recovered and conditioned in the manner previously described while the upper layer of the reaction mass is stripped of solvent and distilled to yield methyl butinol.

Hydration of methyl butinol causes formation of methyl isobutanolone. Methyl butinol is added to a charge of 45 percent sulphuric acid containing mercuric sulphate. This reaction mass is agitated before passing through the continuous reactor and through the continuous evaporation unit. In the evaporator the temperature is raised to 96 deg. C. where azeotropic distillation of methyl isobutanolone and water takes place. This distillate is treated with sodium carbonate and the isobutanolone salted out. The resulting mixture is separated in a liquid-liquid centrifuge. Methyl isobutanolone is then led to storage or it may be used to produce methyl methacrylatone monomer.

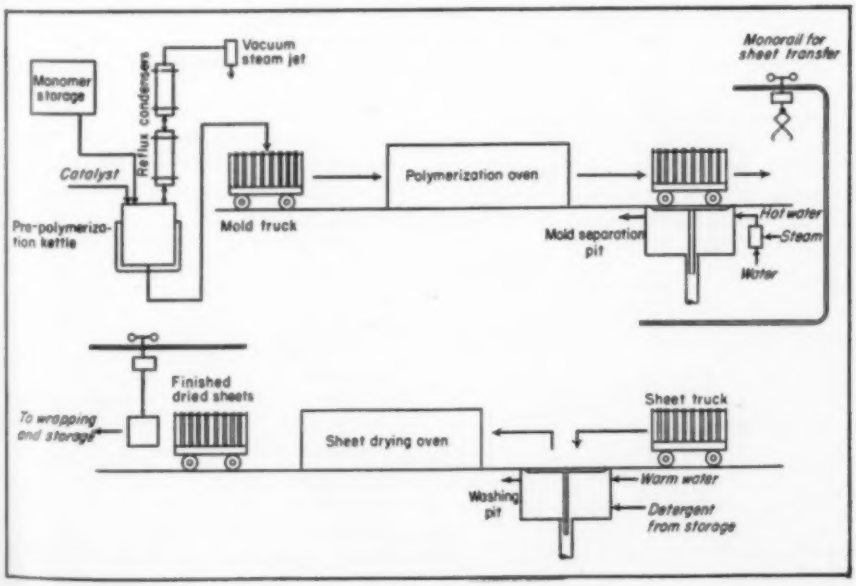
Methyl methacrylatone is produced by a treatment similar to that for the methacrylate monomer. Methyl isobutanolone is dehydrated with phosphorus pentoxide to yield methyl methacrylatone. This is then water washed and separated from the water by freezing and centrifuging to remove the ice.

Sheet Polymer

Methyl methacrylate monomer from refrigerated storage is run into the pre-polymerization kettle. Cold monomer is mixed with catalyst and held at a temperature of 85 deg. C. for 45 min. A reflux condenser on the jacketed kettle is hooked up to a vacuum pump. The polymerization reaction is exothermic in the presence of the catalyst, so it is necessary to hold the temperature to the desired point by application of vacuum. A vacuum of 380 mm. of Hg is used. The reflux condenser is used only for the purpose of preventing losses of monomer which would distill over under vacuum and be lost. After 45 min. at 85 deg. C. the material is chilled to 35 deg. C. by running cold water into the jacket of the kettle. When the material is chilled it is ready to be poured into the molds.

Individual molds consist essentially of two sheets of plate glass, completely without surface flaws, clamped together with a spacer inserted be-

Polymerization process for production of transparent plastic sheet



tween them and around the edges to form the mold. This spacer is a thin strip of cellophane covered rubber of the desired thickness which runs continuously around the periphery of the glass on three sides. Cellophane protects the rubber from the strong deteriorating action of the monomer. The molds which are clamped together are arranged vertically on a truck. Each truck will hold 24 molds. Four trucks of 24 molds, making ½-in. thick sheet, require approximately 1,000 lb. monomer. The trucks are about 6 ft. wide by 13 ft. long. After each mold is clamped together and put in the mold truck it is locked in place. Sheets are 4 ft. square, but the mold is 4 ft. wide by 5 ft. high, which allows 12 in. for vertical shrinking. When the molds are filled with pre-polymerized monomer the truck is pushed into a polymerization oven. The oven consists of a structural steel frame made of 6-in. I-beams with transite sheet on both sides and filled with rock wool insulation. It is a simple truck type oven. The tracks upon which the trucks run are sloped slightly so that the trucks may be readily handled. Hot air enters at the bottom on the sides of the dryer through ducts.

Polymerization schedules differ for the various thickness of sheets. For the ½-in. sheet the polymerization schedule is 50 min. at 85 deg. C., then 3½ to 4 hr. at 60 to 65 deg. C. Then the temperature is raised to 85 deg. C. for the remaining four or five hours.

From the polymerization oven the trucks are removed and lowered into a concrete pit containing hot water at 85 deg. C. for separating the sheet from the mold. This pit is equipped with an overflow drain and an agitator and the trucks are lowered by means of a hydraulic lift. Each truck load of sheets in the mold is left in the pit for about 30 min., during which time the temperature of the water is lowered progressively from 85 to 35 deg. C. by means of a time schedule controller which causes cold water to be added.

When the truck is raised out of the mold-separation pit the sheets are removed from the loosened mold with a monorail hoist by means of a grabbing hook which grips the thin sheets. Sheets are placed in a second similar type truck where they stand in slots. When the truck has been loaded with sheets it is passed into a washing pit containing hot water and detergent. This operation takes ten minutes at about 40 deg. C.

After washing, the truck is removed from the pit and passes into the drying oven where any water on the surface is dried off at a temperature of 60 deg. C. The sheets are wrapped in masking paper for protection, and then stored. Where masking paper is not available or is more expensive, the sheets may be passed through a spray booth and sprayed with a protective coating and dried before storage.

Importance of Catalyst

Heretofore, all processes for making optical grade methacrylate sheets have been by use of horizontal molds. It has not been possible to use a vertical mold successfully because of uneven shrinking and the tendency for flaws to form in the sheet due to uneven shrinkage. Successful use of the vertical mold has been accomplished by a proper selection of polymerization catalysts which permit higher curing temperatures and higher curing rates. Polymerization temperature schedule made possible by this combination of catalysts maintains the sheet in a plastic state so that stresses are relieved simultaneously with polymerization.

Unusual control over the polymerization rate, the mean molecular weight and the dispersion about the mean molecular weight is achieved by using specific combinations of catalysts (organic peroxides other than the commonly used benzoyl peroxide).

Molding Powder

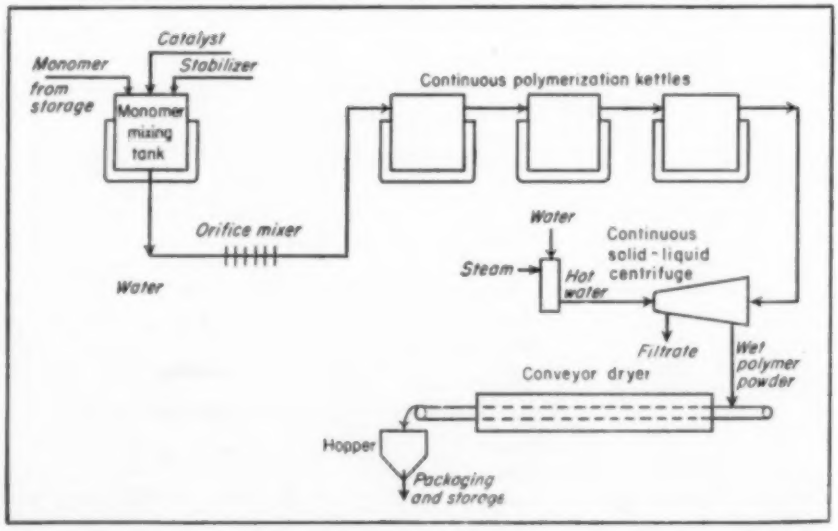
Production of molding powder takes place in a continuous process. Monomer from refrigerated storage, to which polymerization catalyst and stabilizing agent have added, is mixed with water in an orifice type mixer in the volume proportion of 1 to 4 and the mixture passed continuously through a series of three steam jacketed, agitated reaction vessels. Temperature is raised to 80 deg. C. in the first reactor where polymerization takes place as indicated by the formation of a powdery precipitate. This is an exothermic reaction and the temperature rises to about 100 deg. C. in the third reactor indicating that polymerization is complete.

Slurry is then run through a continuous solid-liquid centrifuge where the polymer powder is separated and washed with hot water from a direct steam heater. Washed powder from the centrifuge discharges onto a conveyor dryer where it is dried by a concurrent flow of heated air. Maximum allowable temperature is 90 deg. C. Emerging from the dryer the powder discharges into a hopper from which it is packaged.

The mixed catalyst-principle as used in the sheet polymer process is also employed here. However, it is necessary to use a much greater concentration of catalyst in order to form a lower molecular weight, lower melting point polymer that can be readily softened for use in molding and extrusion processes. Purpose of the stabilizer, added prior to polymerization, is to prevent the particles of polymer from agglomerating.

Acknowledgment is made to A. Brothman & Associates for permission to publish this material. Without the help and cooperation of Mr. Brothman this article would not have been possible. Members of the Brothman organization whose work contributed to the development and engineering of the processes described above include Harry Gold, Rolf Wollan, Robert Gerson, William Rohall, O. J. Vago, and S. Fanshel.

Molding powder is made by a fully continuous polymerization process



GASIFYING COAL UNDERGROUND

J. V. HIGHTOWER
Assistant Editor, Chemical Engineering

UNITED STATES UNDERTAKES CONTROLLED UNDERGROUND GASIFICATION OF COAL IN ALABAMA

CONTROLLED underground gasification of coal that began on January 21 at the Gorgas, Ala., bituminous mine of the Alabama Power Co. is the first such investigation undertaken in the United States. Company officials and Bureau of Mines engineers believe the process may open a way to the profitable use of impure coal and seams too thin to mine, as well as allow a more nearly complete recovery of coal than mining now affords. As presently equipped, the "pilot plant" consists fundamentally of a U-shaped duct in a coal seam through which air and steam are blown to produce combustible gases.

Two major considerations led to selection of the small coal vein at Gorgas as the site at which sustained, controlled underground gasification would be tried. For one thing, it was essential that the experiment be conducted in a vein which could easily and safely be isolated from the main coal deposit. Likewise it was necessary to choose a vein with a relatively shallow overburden which could be conveniently stripped at the end of the work.

In choosing the site which satisfied these considerations a disadvantage had to be incurred—the light 30-ft. overburden is subject to burn-outs and has limited air input to around 1,400 cu.ft. per min. at 1.5 psi. gage. This limitation, in turn, has kept the equilibrium temperature, during air blasting, to approximately 1,250 deg. F., with the result that the heat content of the make gas during air blast operations has been held to the range of 50 to 80 B.t.u. per cu.ft. Inability to maintain the desired higher temperatures has also been reflected in relatively low heating values of gas produced in runs of the water gas type.

Fact Finding Experiment

Despite these handicaps it is expected that the work at Gorgas, or later efforts at some other location, will yield valuable information on operating problems, types and quantities of useful products and costs of operation. The Gorgas project is regarded primarily as a fact-finding experiment, intended to determine the practicability, in this country, of a process which has already been applied commercially in Russia and will be tried soon in abandoned mines in Belgium. Russian plans call for underground gasification at the rate of about 100 million cubic feet per day by 1950. Currently, the chief interest in the work in Alabama is the study of engineering problems and the completeness of conversion of the coal. It is believed that in about a month the work will reach a point where the small seam can be opened and examined.

From the ultimate viewpoint, the investigation is regarded as important for the light it is expected to throw on the use of underground gasification as a means of producing gas for boilers, gas turbines and manufacture of synthetic fuels and lubricants and other chemicals. It is thought unlikely, however, that the Gorgas project will be more than a preliminary effort leading the way to later development.

Various difficulties, most of them expected, have been encountered in the operation. As stated above, the lightness of the 30-ft. overburden has not permitted the pressure of steam or air in the burning bed to be increased much over 1.5 psi. Even with this low pressure, burn-outs have occurred, necessitating the application of bags of clay and gunnite around the seam, thereby closing the apertures used for observing the progress of combustion. In March, gunnite had been applied to a thickness of 4 in. around the overburden. Engineers do not believe that burn-outs will be a serious obstacle if

To the chemical engineer the experiment in controlled underground gasification of coal is of interest because of the possibilities it offers as a means of producing a raw material from which chemicals, synthetic fuels and lubricants can be made. While it is thought unlikely that the Gorgas project will be more than a preliminary effort leading the way to later developments the potentialities make it worth watching.

Top of overburden showing pipes through which temperatures, pressures and gas samples are taken

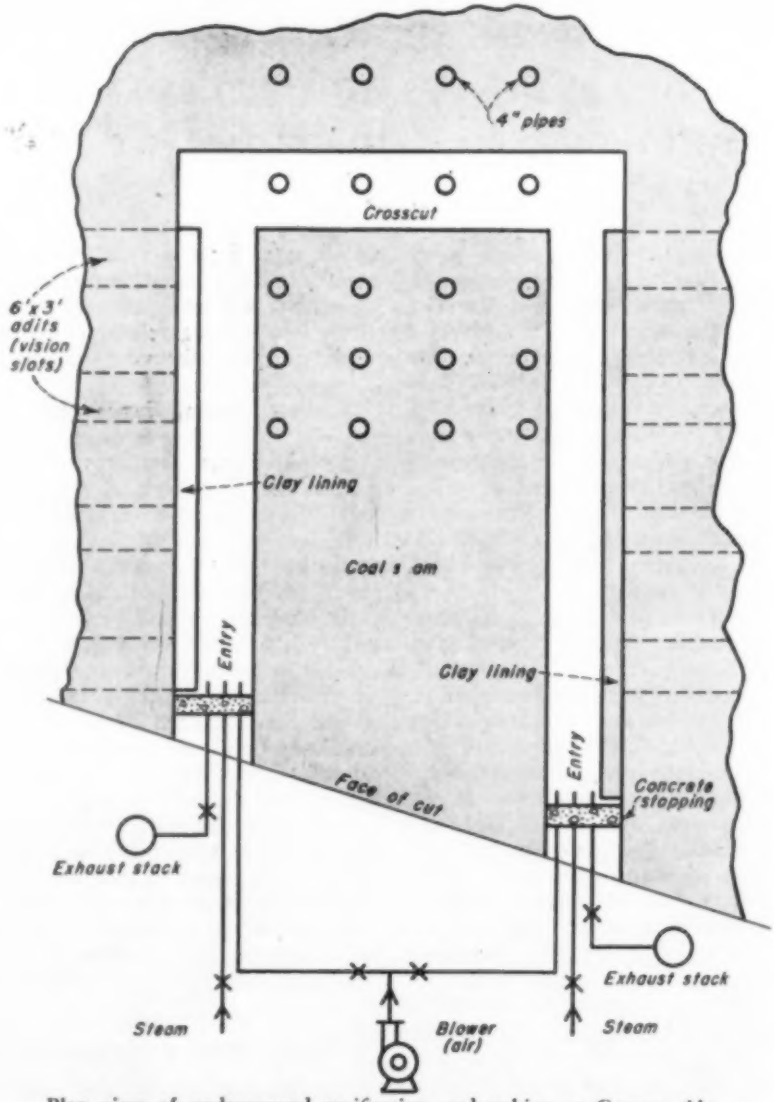
By taking periodic sights on scales painted on pipes settling of overburden can be measured as coal burns

the operation is applied to better covered seams.

The Alabama Power Co., operator of extensive coal property in the region, is interested in means of developing cheap fuel for its 200,000 kw. steam power plant ¾ mi. from Gorgas. The company is also planning construction of a 240,000 kw. plant near Gadsden, Ala. In view of its direct interest in developing low-cost fuel, the company has undertaken the work at Gorgas in cooperation with the Bureau of Mines of the Department of the Interior and also the Southern Research Institute. These two agencies have been contributing technological and operating assistance and the company has been financing the venture as well as furnishing personnel.

Selected Seam

The seam selected for the Gorgas experiment is a small peninsular strip cut off from the main bed. Through this horizontal, 36-in. vein was cut a U-shaped combustion duct, consisting of one entry 140 ft. long, another 170 ft. long, and a 40-ft. crosscut. The cross-sectional dimensions of the duct were 6 ft. (width) x 3 ft. (height). Bags of clay were placed internally along the walls of the entries for the greater part of their length to reduce the tendency of burn-outs to break through the entries away from the main body of the coal. Sealed by a concrete stopping into the opening of each entry is a 24-in. pipe from the air blower, a 2-in. steam line and a 24-in. pipe leading to an exhaust gas stack approximately 40 ft. high. As indicated in the accompanying sketch, a simplified plan view of the installation, the piping arrangement is such that air or steam may be injected into either of the two entries, with combustion gases leaving through the stack at the opposite leg of the duct. Provision was made for this alternate type of flow in order to minimize unequal consumption of the coal.



Plan view of underground gasification undertaking at Gorgas, Ala.

Combustion was started by dropping incendiary bombs through 4-in. pipes sunk vertically through the overburden and adjusted so as to permit the bombs to fall upon broken coal placed in the crosscut. Originally, the progress of combustion could be observed through Pyrex glass vision slots set in eight adits, 6 ft. wide and 3 ft. high, excavated at 25-ft. intervals along the

entries. Because of burn-outs, the adits have all been closed with bags of clay and a covering of gunnite laid over the bags.

Provisions were made to determine differences in pressure, temperature and composition of gases at various points. Through the overburden, 16 pipes of 4-in. dia. were sunk vertically to the top of the seam and capped, with connections through the caps for insertion of thermocouples to the seam and for taking gas samples and pressure measurements. Later, four additional pipes were inserted as combustion began to spread and as some of the original pipes and thermocouples became damaged near the seam. Also, somewhat similar connections were installed at the eight adits along the entries. In addition, temperatures, pressures and gas samples can be taken at the points where the gases enter the stacks.

Spot temperatures in the combustion area, during air blasts, have reached 2,000 to 2,200 deg. F. The average, however, has ranged between 1,300 and 1,500. Higher temperatures have been hard to attain because the resistance to gas movement in the duct resulting from roof falls and undetermined causes has prevented a rate of air input sufficient to produce the desired temperatures.

Several types of operation have been carried out at Gorgas, principally continuous air blasting to manufacture producer-type gas and alternate runs with air and steam for the production of water gas. A short period of oxygen injection was also tried. In view of the present brief span of the experiment, and because of operating difficulties which are believed ultimately susceptible of solution, officials do not wish at this time to express any final conclusions on the work, beyond saying that it is a promising start and justifies further research.

Officials who have followed the work at Gorgas have released a small amount of data to indicate the character of the make gases. They emphasize, however, the previously discussed limitation on air input and its injurious effect upon the quality of the gases produced.

An example of quality of 55 B.t.u. gas produced during an air blast run, during which production was estimated at the rate of 1,400 cu.ft. per min., is labeled Run A in the accompanying table.

Quality of Gas

An indication of the quality of water gas production is seen in the analysis of a sample make gas produced during a steam run of about two hours (Run B). It was estimated that during this steam run, gas production was at the rate of about 220 cu.ft. per min.

A supply of liquid oxygen was brought to Gorgas with the intention of securing greater intensity of combustion. However, the nature of the equipment available for vaporizing the oxygen limited the oxygen input to about 200 cu.ft. per min. This rate was too low for best results, being actually less than the oxygen input included in the maximum practicable air blast rate of about 1,400 cu.ft. per min. In a 3-hr. run (Run C) during which a mixture of 40 percent steam and 60 percent oxygen was passed through the duct, make gas was obtained at an estimated rate of 1,000 cu.ft. per min.

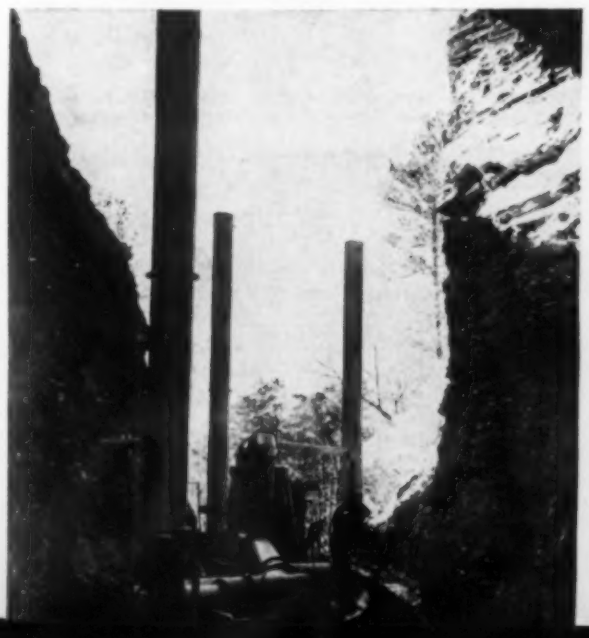
Of much interest to those connected with the investigation is what has been happening to the coal and the overburden. After the burned section has been steamed for several days and then quenched with water, the overburden will be removed and the entire area closely examined.

Quality of Gas Produced at Gorgas in Test Runs Using Air, Steam, and Steam and Oxygen

	Run A	Run B	Run C
Production rate, cfm..	1,400	220	1,000
B.t.u. per cu. ft.....	55	222	150
Quality, vol. percent			
Carbon dioxide....	16.2	26.0	55.4
Oxygen	0.4	1.0	1.4
Illuminants	0.2	0.4	0.2
Hydrogen	7.4	34.4	18.8
Carbon monoxide ..	4.2	19.2	12.6
Methane	1.4	4.3	4.6
Nitrogen	70.2	14.7	7.0
	100.0	100.0	100.0

Alabama Power Co. officials closely connected with the work include M. H Fies, manager of coal operations, and H. M. Johnstone, manager, Gorgas Coal Mines. Representatives of the Bureau of Mines include J. J. Dowd, mining engineer, Fuels and Explosives Section at Pittsburgh; J. L. Elder, chemical engineer, Synthesis Gas Production Laboratories at Morgantown, W. Va.; L. D. Schmidt, supervising engineer, Synthesis Gas Production Laboratories at Morgantown; D. J. Parker, supervising engineer, Health and Safety Branch, Birmingham District; A. C. Fieldner, chief, Fuels and Explosives Branch; L. C. McCabe, chief, Coal Division; W. C. Schroeder, chief, Synthetic Liquid Fuels Division; and L. L. Newman, chief, Foreign Synthetic Liquid Fuels Division. W. A. Lazier, Director of the Southern Research Institute, Birmingham, has furnished technical assistance from that organization.

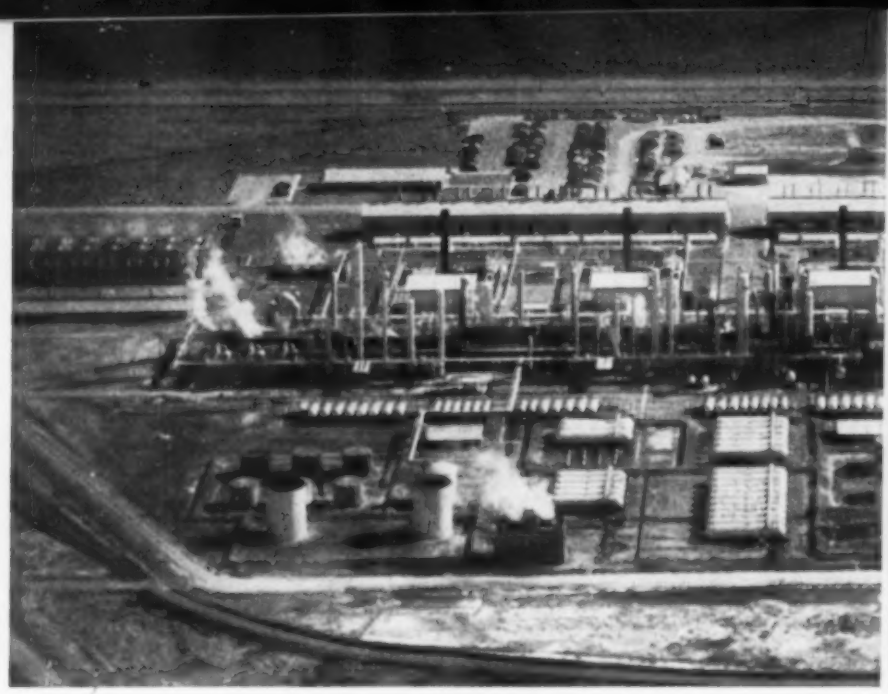
Piping and boiler at Gorgas experiment in controlled underground gasification of coal



Connections for pressure gage, thermocouple and gas sampling beneath Pyrex glass for observing progress of combustion

Photographs supplied by Alabama Power Co., Birmingham Post and Birmingham News

Multiple reactor unit with purification column in background



Aerial view of the first unit of Chemcel plant at Bishop, Tex.,

CHEMICAL EXPANSION

In 1943 ground was broken for the chemical plant of the Celanese Corp. of America. The first unit went into operation the middle of 1945, and since that time the plant has steadily expanded. It is located a half-mile south of Bishop, Tex., and not far from Corpus Christi.

The developments which have led to the production of a whole new group of synthetic organic chemicals and greatly expanded volume in other chemicals never before made from petroleum sources are the outgrowth of an intensive and integrated program of research in the field of petroleum chemistry in which the company began work 15 years ago. For sometime it has produced acetic acid, acetic anhydride, acetone, methanol, formaldehyde, acetaldehyde and other organic chemicals. In addition it has begun volume production of certain organic chemicals that up to now have been obtainable only in laboratory quantities. Among these are two chemicals, whose characteristics make them valuable in industrial applications. These are n-propyl alcohol and propionaldehyde, the latter an intermediate commonly used in the production of certain plastics and organic chemicals.

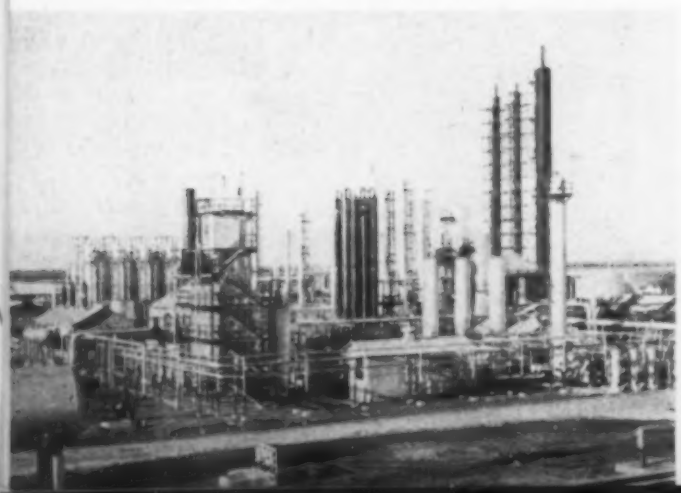
The company now reports that several new and versatile solvents, organic acids and intermediates, heretofore commercially unobtainable, are being developed with a view to making them available to industry shortly.

Bishop is in the heart of abundant supplies of natural gas. Petroleum gases are piped into the plant where they furnish both the raw material and the fuel for virtually the entire operation.

Research Program

The research program which made the achievements to date possible has been expanded through a new 50-acre research center near Corpus Christi for advanced development and research connected with chemicals derived from petroleum and its derivatives. Here a research staff including chemists, and chemical, metallugical, mechanical and electrical engineers, will work

One of the principal units at the Chemcel plant is for the production and purification of propyl alcohol



Volume production of n-propyl alcohol and propionaldehyde has been started at the Bishop, Tex., plant

Celanese Corp. of America. Here synthetic organic chemicals are produced from petroleum

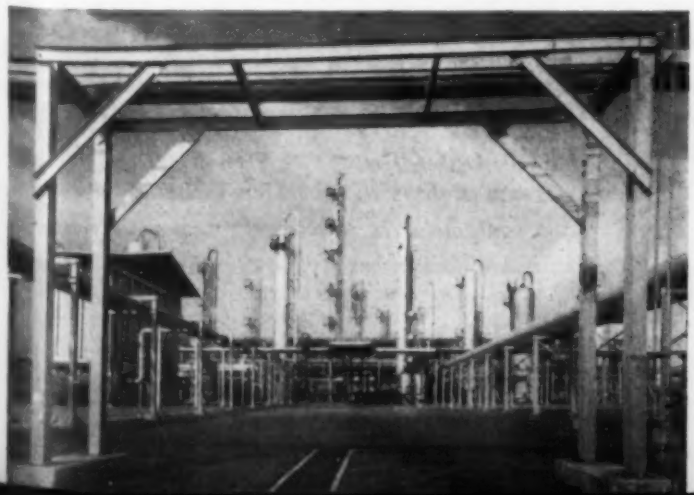
N SOUTHWEST TEXAS

toward further development of the modern processes and equipment of the Chemcel plant. Also, investigations will be made aimed at utilizing present products in other processes to make new or improved materials and a continuous program of research carried on to develop new chemical products.

As the largest consumer in this country of acetic anhydride and acetic acid, two of the most important chemicals used in the production of cellulose acetate for yarn, it was necessary, as a result of planned expansion in the textile and plastic fields, that the company develop additional supplies of these two chemicals. Meanwhile, the company continued to maintain its position as a leading supplier and producer, in its Newark, N. J., plant, of organic phosphates for use as plasticizers, lubricants and lubricant additives for motor oils. By the time World War II was about to begin, the company had developed at Cumberland, Md., a new process for the volume production of acetic anhydride and acetic acid and was ready to proceed with designing a large scale plant. This project was shelved temporarily because of the war until, with growing shortages of basic organic chemicals, the government requested the company to proceed with the construction of the plant to produce such chemicals and to work on a new method of making butadiene. Bishop, Tex., was selected as the site for the plant because it is in an area known to be a rich source of natural gas.

The Chemcel operation, which consists essentially of taking basic hydrocarbon gases and rearranging the molecules to produce an almost unlimited number of chemical compounds, is so flexible that Celanese can quickly meet the changing needs of chemical markets. Production can be concentrated on any particular group of organic chemicals or shifted to other groups in accordance with industry demands. In addition, the company's ability to fill its own requirements for chemicals made to rigid specifications and used in manufacturing its own textiles and plastics has been greatly facilitated.

Chemcel plant is in heart of abundant supplies of natural gas, and embodies new processes and equipment



One of the largest installations of gas-driven compressors in the country

DETECTING LEAKS

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MASS SPECTROMETER TYPE OF LEAK DETECTOR IS INVALUABLE IN MAKING CHEMICAL PLANT EQUIPMENT TIGHT

DURING the past few years the mass spectrometer type of leak detector has leaped from a laboratory gadget to a standard industrial instrument. Originally developed to meet a critical wartime need, this instrument is now being applied to a variety of industrial problems.

Mass spectrometer leak detectors have already been put to work in many industrial plants and laboratories to accomplish things that were difficult or impossible without them. They are now being used to test the following products:

Air conditioning parts
Refrigerator parts
Gas tanks
Hermetically-sealed instruments
Rectifier tanks and sealed tubes
Vacuum pumps
Vacuum valves and fittings
Laboratory vacuum systems
Vacuum tubes
Radio transmitting tubes
X-ray tubes

This incomplete list is but a small measure of the useful range of the mass spectrometer leak detector, whose industrial applications are really just beginning.

It might be well to review the essential elements of the leak detector at the start. The heart of the instrument is the mass spectrometer tube, which electro-magnetically separates atoms of helium from other atoms and molecules. The tube consists of a source assembly for ionizing a gas mixture, accelerating and focusing the ions; an Alnico magnet which produces a permanent magnetic field; and a collector-end assembly for receiving and translating positive ions of helium into a voltage signal. The mass spectrometer tube has associated electronic circuits to supply ionizing, accelerating, and focusing voltages and to amplify the voltage signal obtained at the collector end.

The spectrometer tube is maintained at a high vacuum by means of a pumping system, consisting of a mechanical rough pump, a diffusion pump, and a cold trap. The vacuum in the tube is measured by means of an ion gage and its associated electronic control. In operation, the lead detector vacuum system is a dynamic one, with gas entering through the gas inlet line, flowing through the spectrometer tube, and then exhausting through vacuum pumps.

Basic Procedure

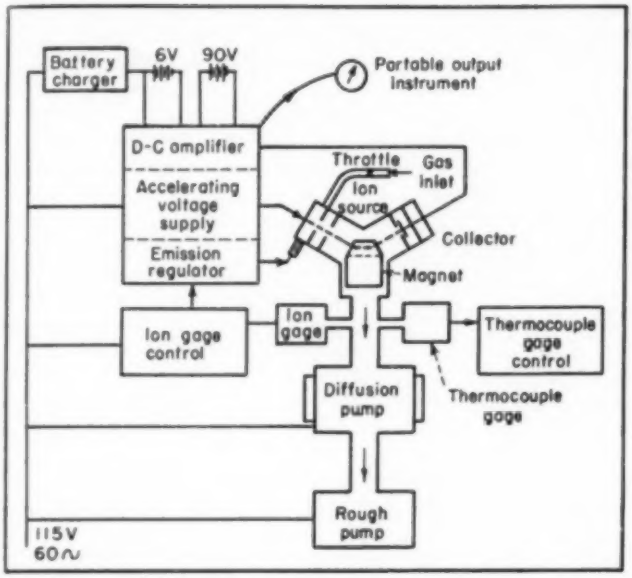
Use of the leak detector is basically simple. The instrument is connected to the object to be tested by means of a high-vacuum connecting line. Inserted in this line is a throttle valve, which is initially in the closed position. The object under test is then evacuated by means of a pumping system external to the leak detector. This system operates continuously unless the test object is small, whereupon the pumps may be closed off by means of a vacuum valve. The valve is then opened to allow a continuous sample of gas from the system to be drawn into the leak detector. The throttle valve can be adjusted to maintain the correct operating pressure in the leak detector over a wide range of pressure in the object under test.

Assuming that the leak detector itself has been set up for operation, all that is necessary to do is to turn on the filament of the spectrometer tube to ready the instrument for almost instantaneous detection of minute quantities of helium. The outside of the object under test is then either covered with a hood and flooded with helium for an over-all leak test, or probed with a fine jet of helium to detect individual leaks. When the helium covers or passes over a leak, some of it passes into and quickly diffuses throughout the evacuated system. All or a portion of this helium is pumped through the spectrometer tube of the leak detector where its presence is detected.

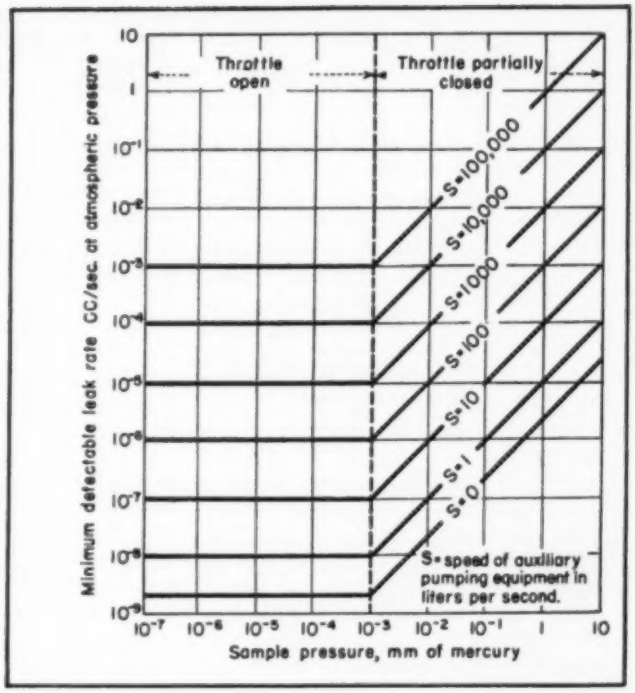
The usual procedure is to hood-test an object, and then to probe with the helium jet only if leaks are revealed in the former test. By using a fine jet of helium it is possible to locate individual leaks within approximately $\frac{1}{8}$ in. The time lapse between the jet of helium striking the leak and the indication on the instrument is usually a few seconds.

A positive check on the operation of the leak detector can be made by the use of a "calibrated" leak inserted into the object or system under test. The calibrated leak will allow a known amount of helium to pass into the system; and by noting the deflection on the leak detector output circuit the sensitivity of the system can be established. In addition, the size of a leak

To the mass spectrometer leak detector goes a large share of the credit that is due for making the gaseous diffusion plant at Oak Ridge operate successfully. This detector was used widely at Oak Ridge for checking vacuum tight systems which included piping, tanks and other process equipment. It lends itself to a wide range of applications. The author discusses several that should serve to suggest similar uses in the chemical process industries.



Above—Block diagram of G-E leak detector



Right—Typical leak detector sensitivity curves

can be determined by comparing the leak detector deflection against that for the calibrated leak.

Applications

The leak detector lends itself to a wide range of applications which can be divided into a number of distinct categories, each covering a broad field in itself.

One use of the instrument is to test dynamic vacuum systems for tightness. These systems may range in size from small laboratory set-ups consisting largely of glass parts to large all-metal vacuum systems such as might be encountered in vacuum stills or furnaces.

Use of the leak detector with these dynamic vacuum systems is simplicity in itself, since practically no auxiliary equipment is required. As the dynamic vacuum system has its own vacuum pumps, it is necessary only to connect the instrument to the system by means of rubber or metal vacuum tubing. The throttle valve, of course, is inserted in this line, preferably near the system under test. The only other equipment necessary is a tank of helium with its regulating valve. After the throttle valve has been adjusted to allow the leak detector to take its continuous sample of gas, the dynamic vacuum system can be leak tested by either the hood or jet probe methods.

The sensitivity of the test will be determined by the pumping speed of the vacuum system together with the degree of vacuum in the system, as indicated by the leak detector sensitivity curves. Maximum sensitivity is obtained when the vacuum can be brought down to about 1 micron and the pumps valved off the system, allowing the leak detector pumps to maintain the required vacuum. This, of course, is only possible on small, tight systems having little out-gassing.

Another logical application is testing any object which can be evacuated. These objects range from small vacuum tubes and pieces of high-vacuum "plumbing" to large pipes and tanks. While it is possible to test small objects by using the leak detector itself to evacuate them, it is usually best to provide some auxiliary pumping equipment.

Depending upon the size of the objects and the required speed of testing, the necessary auxiliary equipment will range from a small mechanical vacuum pump to an elaborate set-up consisting of vacuum pumps and test manifolds. To test a few small objects requires only a small pumping system. If production testing of small objects is required, then it is essential to add a test manifold in addition to a larger pumping system.

The manifold consists essentially of a large vacuum pipe with a number of valved connections, to which are attached the objects to be evacuated and tested. The size of the manifold and pumping system, of course, is in direct proportion to the size and number of the objects to be tested. To test large pipes and tanks, the manifold is usually omitted, and the pipe or tank is directly connected to the inlet of the pumping system. For these large pieces, the pumping system itself must be large in order to evacuate and maintain a satisfactory vacuum in the object under test.

It is not necessary, or even possible, to maintain an extremely high vacuum in all sizes of objects under test. By referring to the typical leak detector sensitivity curves it can be seen that the maximum sensitivity depends upon the pumping speed of the auxiliary evacuating system and the degree of vacuum obtained. Large objects, requiring greater pumping speeds in the auxiliary equipment, will not be tested at maximum sensitivity. This is really no disadvantage, since a large object can stand a relatively larger leak than a small one can.

A third application of the instrument is to test for leaks in sealed gas-filled objects. To do this, the instrument is used in a similar manner to the second application, but in this case the objects are filled wholly or partially with helium and surrounded externally with a vacuum. The surrounding vacuum is obtained by placing the objects in a vacuum chamber which is connected to a pumping system and to the leak detector. The object to be tested is first filled with helium, or a mixture of helium and other gases, at pressures ranging from a fraction of an atmosphere to several atmospheres, and then sealed off.

The object is next placed in the vacuum chamber, which is first evacuated with its own pumping system, and then connected to the leak detector by

opening the throttle valve. A leak in the object, of course, will allow helium to enter the vacuum chamber and have its presence sensed by the leak detector.

By this means hermetically-sealed objects may be tested after sealing, as well as objects designed for high internal pressures. Because of its inert character, the presence of helium for test purposes in a hermetically-sealed object is usually not objectionable, and often advantageous. The absolute sensitivity of the test, of course, depends upon the size of the object, vacuum chamber, and pumping system, and will be at a maximum when these are all small.

A fourth application of the leak detector is similar in operation to the third. Instead of placing an object in a vacuum chamber, leaks are found by flooding or probing one portion of the object while the opposite side is covered with an evacuated chamber connected to the leak detector. Leaks through gaskets, joints, valve seats, etc., can then be found. With proper care in obtaining a vacuum-tight seal between the object under test and the portable vacuum chamber, good sensitivity can be obtained.

Testing Large Objects

To test a large steel tank of about 75-cu.ft. capacity (a mercury arc rectifier) a leak detector was connected directly to the tank by means of ¼-in. I.D. copper tubing. Since the rectifier had its own high-vacuum pumping system, it was not necessary to provide additional pumps for evacuating the tank as would ordinarily be necessary. The basic test procedure, as previously outlined, was followed, making use of both hood and probe techniques.

Previous to the use of the leak detector, seepage tests made on the tank had indicated a leakage rate of about 75 micron cu.ft. per hr. When the leak detector was used to check this leak, its response was such that a leak of only 0.75 micron cu.ft. per hr. could have been detected. (1 micron cu.ft. per hr. is equal to about 1×10^{-4} standard c.c. per sec.). After repairs to the tank were completed, a leak test was made with an indicated sensitivity of 0.1 micron cu.ft. per hr., which was 0.5 percent of the allowable leakage rate for this tank.

On this job the leak detector replaced the old standard means of finding leaks by seepage tests and by painting with a soap mixture with the tank under pressure. In comparison with these methods, the leak detector could find a much smaller leak faster, with greater accuracy, and without contaminating the equipment under test. In addition, the test was made with normal (instead of reversed) pressure difference across all parts of the tank, and could have been made with the tank at its normal elevated operating temperature. These advantages derived from this method can be realized in testing a large variety of tanks, pipes, and similar sizable objects.

Testing Small Objects

The Sperry Gyroscope Co. is now utilizing the maximum sensitivity of a leak detector to test Klystron tubes. For this work the instrument is connected to a small high-vacuum manifold system, which is evacuated by means of a cold trap, a glass mercury diffusion pump, and a mechanical rough pump. The basic test procedure is used with this set-up.

Since the objects under test and the manifold are both small, it is possible to valve off the manifold after evacuation by the pumping system and open wide the throttle valve connecting the instrument to the manifold. This, of course, allows operation at maximum sensitivity, making it possible to detect a leak in the order of 10^{-9} standard c.c. per sec.

Before this method was used, the tubes were tested by watching the response on an ion gage when alcohol was sprayed on the suspected leaks. This was slow, and not sensitive enough to maintain the required high standards. By using the leak detector it was possible to find accurately and quickly much smaller leaks than ever before. In addition, the new method made it possible to re-check quickly a suspected leak, a procedure which was previously difficult.

Economically speaking, the personnel using the instrument are of the opinion that it was an investment which would soon pay for itself. Although the objects being tested on this set-up happen to be vacuum tubes, the same type of equipment can be used to test any small object which can be evacuated.

Production Testing

For production testing hermetically-sealed instruments, Kearfott Engineering Co. utilizes the leak detector connected to a manifold system. The test system is actually a double manifold made of 3-in. copper pipe, and evacuated by two rough pumps, each having a rated capacity of 46.8 c.f.m. By means of 3-in. vacuum valves, half of the manifold can be connected to the leak detector for test purposes, while the other half is used for evacuation or drying out of other parts. These parts of about 0.1 cu.ft. volume are connected to the manifold by means of compression couplings mounted on vacuum valves extending from the manifold.

Basic test procedure is used on this system, with the containers for the hermetically-sealed instruments being first hood-tested and then probed if necessary. During the test, the vacuum maintained in the manifold system by the mechanical pumps is in the order of 50 microns. Standard leaks, connected into each half of the manifold by means of vacuum valves, are used to give a positive check on the operation of the entire system. By means of these standard leaks it has been established that the system will detect leaks of about 1×10^{-6} standard c.c. per sec.

The previous method was to fill the parts with compressed air and immerse them in water, relying upon visual observation of air bubbles.

The test system used by this company can be applied to leak-testing of a large variety of objects on a production basis. In fact this type of manifold and pumping system has already been widely used. However, certain modifications, such as the addition of diffusion pumps and cold traps between the manifold and the mechanical vacuum pumps, have sometimes been made to increase the pumping speed and ultimate vacuum of the system.

Maintenance

Despite the scientific atmosphere surrounding the leak detector, it doesn't require a physicist or an engineer to use the instrument. Any person who is interested in learning a few simple procedures can become a proficient operator. Operations required range from starting up the instrument and shutting it down, to the actual probing or hood-testing for leaks.

However, for trouble-shooting and over-all supervision of operation and maintenance, it is advantageous to have a technically-trained person familiar with both electronic circuits and high vacuum. Maintenance is not excessive, and can be very low, as indicated by the fact that one instrument has been running for over two years with little more than routine changing of the easily replaced spectrometer tube filaments. Sufficient information and service is generally available to get the average industrial user off to a good start, after which he can proceed under his own power.

Combustion Calculations For Hydrocarbon Fuels

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A SIMPLIFIED SYSTEM BASED ON THE CARBON-HYDROGEN RATIO AND CARRIED OUT LARGELY BY NOMOGRAPHS. FIRST OF TWO PARTS

This is the first half of an article designed to make it easy to figure combustion problems for hydrocarbon fuels. Air requirements, stack losses and flame temperatures may be determined simply and graphically. The variables of air humidity, air temperature, and dissociation of carbon dioxide and water vapor are taken into account. The trick has been to correlate specific heat and heat of combustion with the weight ratio of carbon and hydrogen. This use of the carbon-hydrogen ratio as a sort of "common denominator" makes the system particularly applicable to liquid petroleum fuels, since that ratio can be obtained empirically for almost any petroleum fraction by standard physical tests.

THERE has been a considerable need for simplified methods of combustion calculations which are applicable to a wide variety of fuels. It appeared that less time consuming methods might be developed for liquid and gaseous hydrocarbon fuels, mainly petroleum products, since their content of non-hydrocarbon materials is very low and their combustion easily carried to completion. There are some existing graphical methods for such calculations but they are usually applicable to only one type of hydrocarbon fuel, such as kerosene or No. 2 fuel oil, and considerable errors result in their use due to wide variations in chemical composition of fuels which are merely classified by their distillation range. Even methods that take variation of chemical composition into consideration usually have major inaccuracies due to necessary simplifying assumptions or the use of obsolete specific heat and dissociation data.

It has been previously shown that the carbon-hydrogen weight (C/H) ratio is an excellent basis for combustion calculations as they apply to hydrocarbon fuels. The main disadvantage of this criterion was the difficulty in obtaining it with sufficient accuracy by simpler methods than ultimate analysis. This difficulty has now been overcome as far as most liquid petroleum fuels are concerned. By a new empirical correlation the C/H ratio of liquid petroleum fractions within the boiling range of 300 to 800 deg. F. may be estimated within 3 percent maximum error and 1 percent arithmetic average error. The criteria used in this correlation are the 50 percent ASTM boiling point, the 10-90 percent ASTM distillation slope (S), the API gravity, and the ASTM aniline point. It is based on the correlation for pure hydrocarbons by Cauley and Delgass[3] which employs the boiling point, the API gravity, and the ASTM aniline point (see Fig. 1). In order to apply the pure hydrocarbon correlation to liquid petroleum fractions, the 50 percent ASTM boiling point is substituted for the boiling point and the "equivalent pure hydrocarbon" C/H ratio (R') obtained thereby is corrected for the effect of the blending characteristics of the numerous pure hydrocarbons in the petroleum fraction on the aniline point and the boiling point by means of the 10-90 ASTM distillation slope (S). This relationship can be expressed in the form of a correction of the equivalent pure hydrocarbon C/H ratio (R') as obtained by Fig. 1.[2, 4]

$$R = R' + 0.0371\, S^{0.133}\,[(R')^2 - 30.0] \qquad (1a)$$

Since this method of obtaining the emperical C/H ratio for a liquid petroleum fraction (R) is still too time-consuming for routine industrial application further simplification is obtained by calibrating the C/H ratio (R') scale of Fig. 1 for a group of petroleum products of similar 10-90 slope. For No. 1 through No. 5 fuel oils and a variety of related fractions the insensitive term $S^{0.133}$ is practically constant.[4] The resulting correction is entirely a function of R' and R can be obtained directly from the Diesel Index (0.01 × API gravity × ASTM aniline pt.) and the 50 percent ASTM boiling point:

$$R = R' + 0.0417\,[(R')^2 - 30.0] \qquad (1b)$$

In Table I below a comparison of the C/H ratio obtained by Equations 1a and 1b, and the U.O.P. K Factor method is given. The calculation of

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the C/H ratio from the U.O.P. K factor involves the assumption of the percentage hydrocarbon in the petroleum fraction. A variation of 100 percent for kerosene to 98 percent for residual fuels is considered sufficiently accurate assumption. The C/H ratio can then be calculated from the percent hydrogen obtained from the correlation by Watson, Nelson, and Murphy.[20] The molal average boiling point was obtained from the 50 percent ASTM boiling point and the 10-90 slope to calculate the U.O.P. K factor but for general application the 50 percent ASTM boiling point is often used as such. For 16 samples ranging from kerosene to recycle stock and No. 5 fuel oil (10-90 slope 1.2 to 4.5) the following errors resulted for the C/H ratio:

Table 1—Errors in C/H Ratio for Different Methods of Calculation

C/H Ratio Correlation	Arithmetic Average Deviation, Percent	Maximum Deviation, Percent
U.O.P. K Factor	2.6	−5.0 to 6.1
Eq. 1a	1.1	−2.6 to 2.4
Eq. 1b	1.2	−3.2 to 2.6

For gasolines containing large quantities of aromatics the method of Fig. 1 and Equation 1a is expected to be considerably less accurate since low boiling aromatics do not fall on the basic pure hydrocarbon correlation. For residual fuels the aniline point is often not available and the U.O.P. K factor method must be used in such cases. Modern methods for obtaining the aniline point which employ a photoelectric cell[1] instead of visual observation and continuous development of mixed aniline points may eventually make the use of the U.O.P. K factor method unnecessary even for residual fuels, and will, of course, make of even more ready applicability correlations such as this depending on the aniline point. Many of the empirical methods of combustion calculations presented here may be applied to hydrocarbon gases. The C/H ratio for such gases is obtained by standard analytical methods. Calculations of the C/H ratio from Orsat analyses, i.e. from the percentage of CO_2 and O_2 in the dry flue gas in case of complete combustion, is another approximate method. In order to obtain a reasonably good value, the average of ten determinations at varying amounts of excess air should be taken. Such approximate values of the C/H ratio may be obtained quickly from Fig. 3.

In this paper, correlations of specific heat, heat content, and heat of combustion of petroleum fractions with the C/H ratio are presented to integrate the entire system of combustion calculations on the basis of the C/H ratio. While previous correlations for these properties are available, the new methods developed here allow a direct interrelation of the calculations with those for other functions also made on the basis of C/H ratio. Other correlations developed for this purpose include: (1) Heat content of flue gas constituents and air with absolute temperature; (2) air requirements and excess air with C/H ratio and percent CO_2 in dry flue gas; (3) minimum stack loss and stack loss due to excess air with percentage of carbon dioxide in the dry flue gas, flue temperature, and C/H ratio of the fuel; (4) dissociation of carbon dioxide and water vapor for the case of combustion of hydrocarbon fuels with theoretical air requirements, with flame or flue gas temperature and the C/H ratio of the fuel; (5) maximum flame temperatures with the C/H ratio and the heating value of the fuel.

The above correlations are all presented in the form of equations which may be used as such. For convenience and ready use, nomographs have been prepared to solve the equations for stack losses, maximum flame temperatures, air requirements, and excess air. Nomographs are also presented to correct for temperature and humidity of air supply and for the temperature of the entering fuel.

Specific Heat and Heat Content of Liquid Petroleum Fractions

The heat content of the entering fuel is necessary for heat balances. A correlation of specific heat and C/H ratio at 68 deg. F. using the most recent data found in the literature, including the widest possible variation of chemical structure, was developed from 46 pure compounds. The range of maximum deviation is from −6.2 to 6.4 percent and the arithmetic average deviation is 2.2 percent. (The listing of compounds and their properties and the mathematical method of reduction are not given because of lack of space.)

$$[C_p]_{68\ deg.\ F.} = 0.524 - \sqrt{0.01323 - (0.020R - 0.219)^2} \quad (2)$$

This equation holds for values of R between 5.21 and 11.

The temperature coefficient for petroleum fractions was reduced to a new empirical equation using the data of Fortsch and Whitman,[9] Weir and Easton,[20] and Gary, Rubin and Ward.[7] It is somewhat simpler but corresponds very closely numerically to the average temperature coefficient obtained by Watson and Nelson[18] from the same data:

$$[C_p]_t = [C_p]_{68\ deg.\ F.} (0.001221t + 0.916) \quad (3)$$

The heat content of liquid petroleum fractions above 60 deg. F. can then be obtained from Equations 2 and 3 by integrating Equation 3 between 60 and t deg. F.

$$h_t = [0.0006105t^2 + 0.916t - 57.2] [0.524 - \sqrt{0.01323 - (0.020R - 0.219)^2}] \quad (4$$

Equation 4 is plotted in nomographic form in Fig. 2. Additional error corresponding to an error in R of 5 percent is negligible if R is 6 or higher.

Heat of Combustion of Liquid Petroleum Fractions

On the basis of 32 pure liquid hydrocarbons, including the widest possible variations of chemical structure, the heat of formation of liquid hydrocarbons at 77 deg. F. (which equals 25 deg. C., at which temperature most heats of combustion are reported) and constant pressure, was correlated with the C/H ratio. The heats of formation were calculated from the most recent heat of combustion data obtainable from the literature and based on the heats of combustion of graphite and hydrogen determined by Rossini et al.[15, 17]

$$Q_f = 1{,}995 - 199R \quad (5)$$

This expression is not sufficiently accurate to find the heat of formation of specific pure compounds, since an average deviation of 70 B.t.u. per lb. must be expected. It was merely developed to be used as one of the minor factors in the calculation of the heat of combustion. The widest deviation from this equation occurs at a C/H ratio of 5.96, representing the olefins and cycloparaffins. For complex mixtures, such as petroleum fractions, scattering due to variations of chemical structure will be negligible. Using the

Nomenclature

R	Carbon-Hydrogen weight ratio of petroleum fraction.
R'	Carbon-Hydrogen weight ratio of pure compound with equivalent physical properties.
t	Degrees F.
T	Degrees R. (Rankine).
M_x	Excess air, mols per lb. of fuel.
X	Fraction excess air.
x	Fraction of CO_2 or H_2O dissociated.
h_t	Heat content at t deg. F. above 60 deg. F., B.t.u. per lb.
H_t	Heat content at t deg. F. above 60 deg. F., B.t.u. per lb.-mol.
L_d	Heat loss due to dissociation, B.t.u. per lb. of fuel.
Q_n	Heat of combustion or dissociatin at constant pressure, water as liquid, B.t.u. per lb.
Q_f	Heat of formation, B.t.u. per lb.
$L_{min.}$	Minimum stack loss, B.t.u. per lb. of fuel.
p	Partial pressure, atm.
P	Mol fraction CO_2 in dry flue gas.
C_p	Specific heat at constant pressure.
L_x	Stack loss due to excess air, B.t.u. per lb. of fuel.
S	10-90 ASTM distillation slope.
M	Total air, mols per lb. of fuel.
L	Total stack loss, B.t.u. per lb. of fuel.
	Algebraic function of following term.

heat of combustion data of graphite and hydrogen at constant pressure, 77 deg. F. by Rossini et al, the heat of combustion of pure liquid hydrocarbons at constant pressure and the same temperature with water as liquid, is:

$$Q_p = 14{,}100\,[R/(R+1)] + 61{,}000\,[1/(R+1)] - 1{,}995 + 199\,R \quad (6)$$

Since the heat of combustion in technical calculations is usually referred to 60 deg. F., the heat of combustion at 77 deg. is increased by the expression:

$$[Q_p]_{60\ deg.\ F.} = [Q_p]_{77\ deg.\ F.} + 19.3 - 1.2\,R \quad (7)$$

This expression is obtained by assuming a linear variation of the correction between $R = 6$ and $R = 12$.

An analysis of compiled data[6, 11] developed the fact that for fuel oils the approximate loss in heating value due non-hydrocarbon constituents may be estimated empirically:

$$[Q_p]_{Fuel\ Oil} = [Q_p]_{H\ C\ constituents}\,(1.047 - 0.0074R) \quad (8)$$

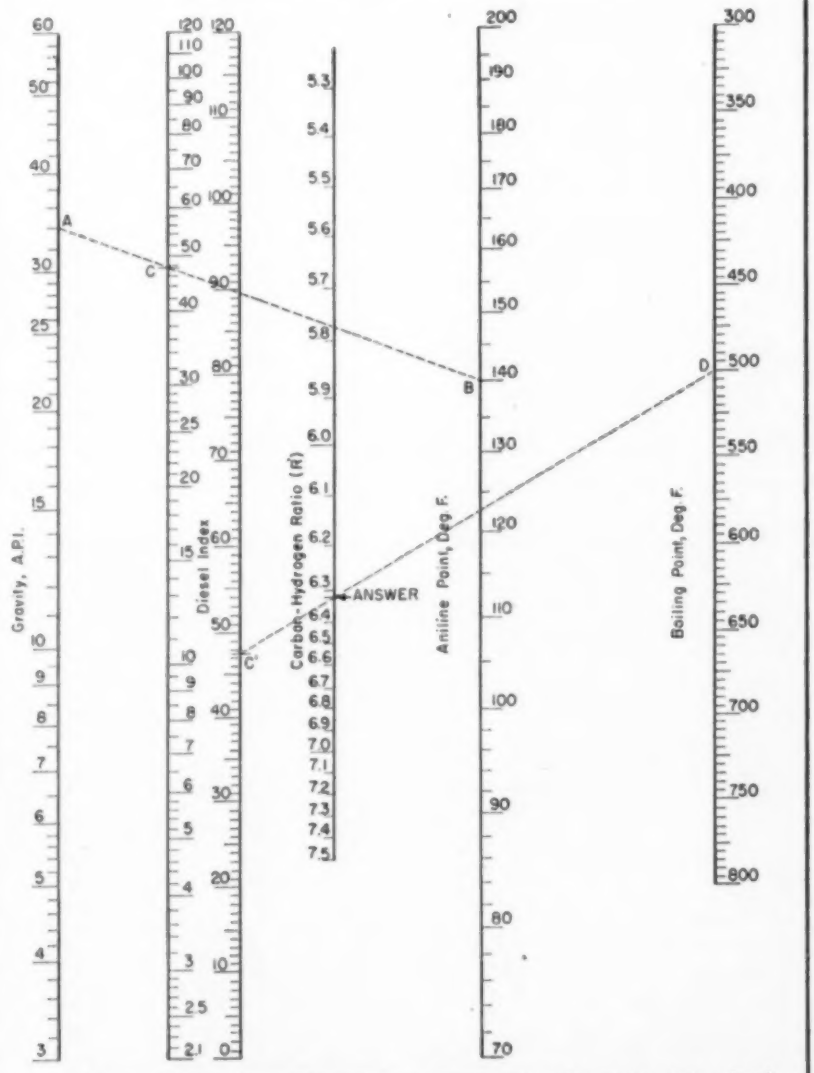
Although Equation 8 has no theoretical basis, it expresses the general tendency of non-hydrocarbon constituents in fuel oils to increase with increasing boiling range and specific gravity. Combining Equations 7, 8, and 6, the heat of combustion of fuel oils at 60 deg. F., constant pressure, and water as liquid, is obtained:

$$[Q_p]_{60\ deg.\ F.} = [(1.047 - 0.0074R)/(R+1)]\,[59{,}020 + 12{,}320R + 197.8R^2] \quad (9)$$

Equation 9, which has a theoretical background, has been tested against known data for 41 petroleum fractions of all types varying from C/H ratios of 5.80 to 10.58. These include ASTM reference fuels Nos. 1 and 2, 26 fractions whose properties are given in "The Science of Petroleum,"[9] and 13 other fuels whose properties are given in "Petroleum Refinery Engineering."[11] All fuels listed were used which had constant and complete data and did not contain over 0.05 percent water or 3 percent non-hydrocarbon constituents. Equation 9 yields results which have an average arithmetic deviation of 0.53 percent and a range of a maximum deviation of −1.54 percent to +1.90 percent from the actual experimental values. The main source of error is the empirical method of compensating for non-hydrocarbon constituents, especially sulphur. In order to make this correlation independent of chemical analyses, the assumption of Equation 8 has been made, but if an analysis of non-hydrocarbon constituents is available, such as the ASTM sulphur value, a more accurate form of Equation 9 could be derived. For the same 41 samples, Cragoe's correlation,[8] which is the most generally accepted, has an average arithmetic deviation of 0.85 percent and a range of maximum deviation of −1.54 percent to 3.17 percent. Since the above comparison of accuracy is based on ultimate analyses which (except for the ASTM reference fuels) are only accurate to 0.1 percent hydrogen, no additional deviation is expected when the C/H ratio is obtained by the method of Fig. 1 and Equation 1a or 1b. At a C/H ratio of 7.70 the deviation due to an error of 0.1 percent hydrogen is equivalent to a deviation of the C/H ratio of 1.04 percent. If other methods are used it should be noted that an error of 1 percent in heating value corresponds approximately to an error of 5 percent in the value of the C/H ratio.

The accuracy of the basic calorimetric determinations did not justify their correction from constant volume to constant pressure, since the heat of combustion, water as a liquid, of a liquid hydrocarbon increases only by

Fig. 1—Related Properties of Pure Hydrocarbons



In order to obtain the equivalent pure compound C/H ratio (R') of a petroleum fraction set the API gravity on the A scale and draw line to ASTM aniline point on B scale. The intersection with the C scale gives the Diesel Index. Set Diesel Index on linear C' scale and draw line to 50 percent ASTM boiling point set on D scale. Intersection with C/H ratio scale gives R'. In order to obtain the actual C/H ratio of a petroleum fraction (R) substitute R' and the 10-90 ASTM distillation slope (S) in Equation 1a. For application to No. 1 to No. 5 fuel oils Equation 1a may be simplified without considerable loss of accuracy by assuming S to be 1.9 (Equation 1b).

Oil and Gas Journal, July 27, 1946

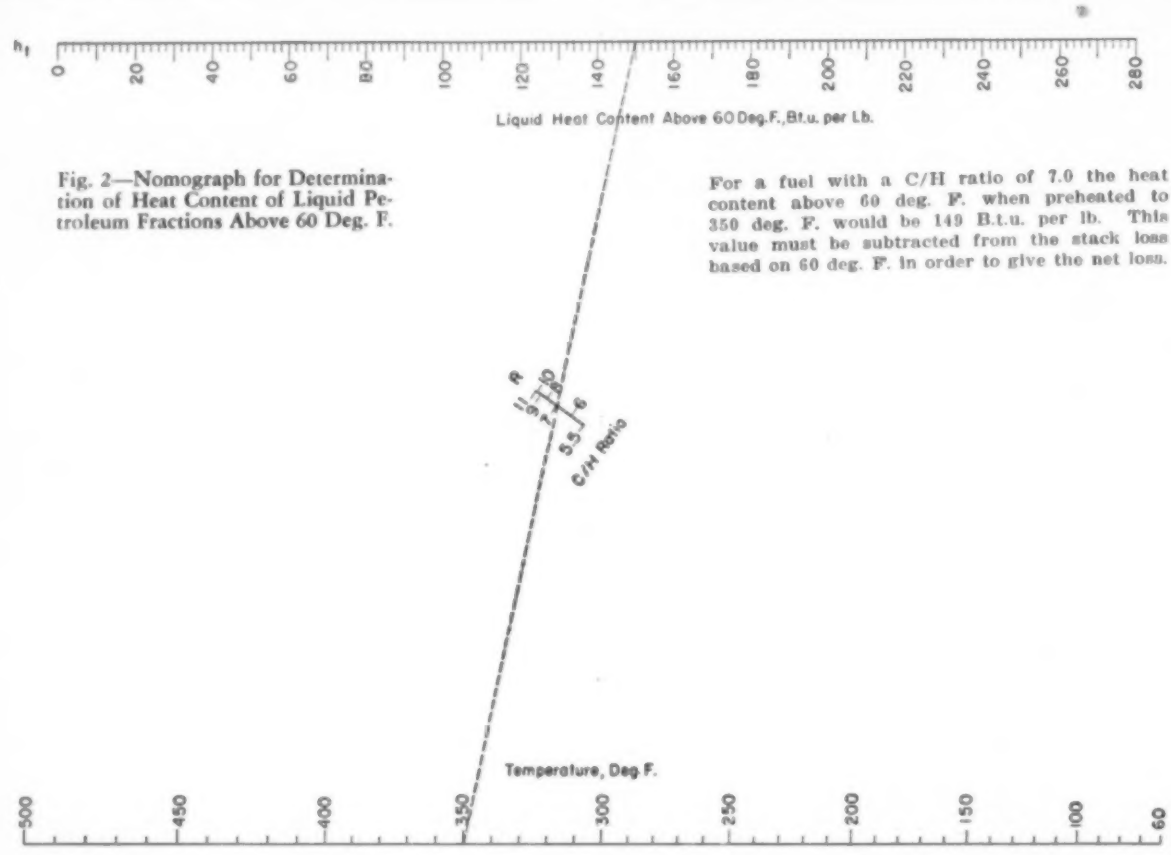


Fig. 2—Nomograph for Determination of Heat Content of Liquid Petroleum Fractions Above 60 Deg. F.

For a fuel with a C/H ratio of 7.0 the heat content above 60 deg. F. when preheated to 350 deg. F. would be 149 B.t.u. per lb. This value must be subtracted from the stack loss based on 60 deg. F. in order to give the net loss.

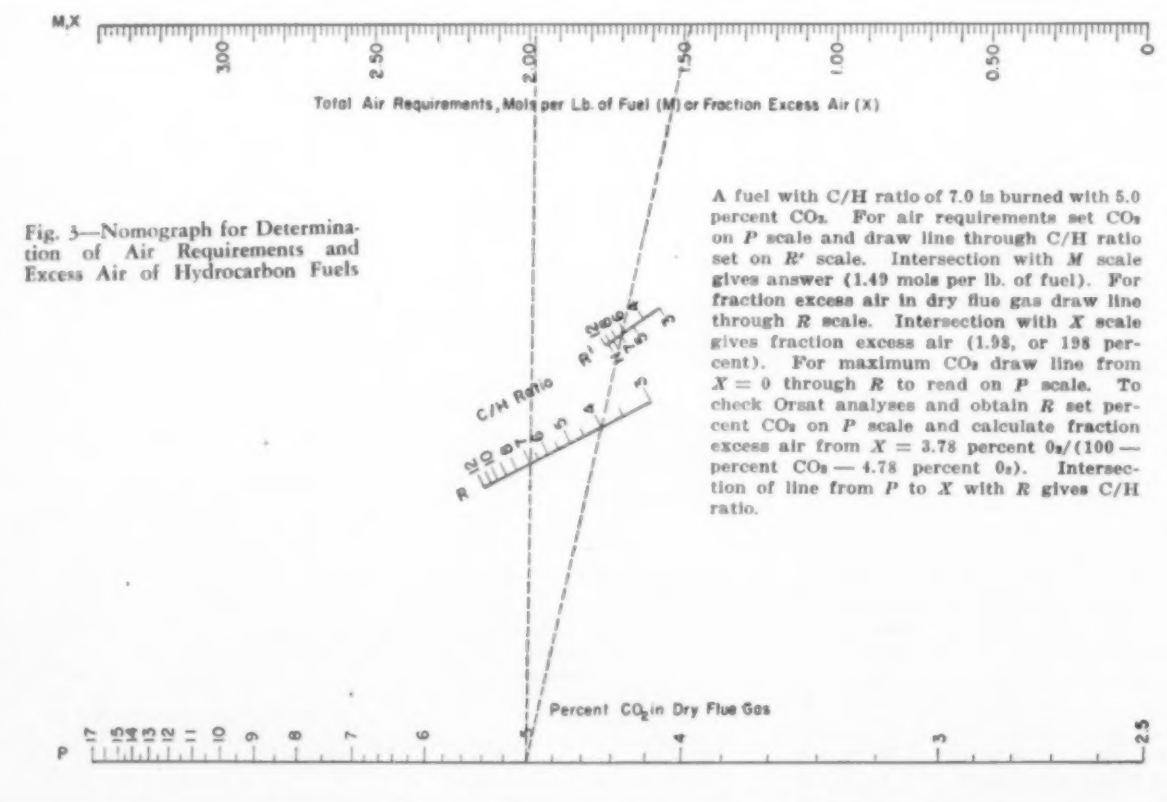

M,X
3.00 2.50 2.00 1.50 1.00 0.50 0
Total Air Requirements, Mols per Lb. of Fuel (M) or Fraction Excess Air (X)
R'
C/H Ratio
R
Percent CO_2 in Dry Flue Gas
P
17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2.5

Fig. 3—Nomograph for Determination of Air Requirements and Excess Air of Hydrocarbon Fuels

A fuel with C/H ratio of 7.0 is burned with 5.0 percent CO_2. For air requirements set CO_2 on P scale and draw line through C/H ratio set on R' scale. Intersection with M scale gives answer (1.49 mols per lb. of fuel). For fraction excess air in dry flue gas draw line through R scale. Intersection with X scale gives fraction excess air (1.98, or 198 percent). For maximum CO_2 draw line from $X = 0$ through R to read on P scale. To check Orsat analyses and obtain R set percent CO_2 on P scale and calculate fraction excess air from $X = 3.78$ percent O_2/(100 — percent CO_2 — 4.78 percent O_2). Intersection of line from P to X with R gives C/H ratio.

0.1 to 0.2 percent at constant pressure over that at constant volume. For convenience of use in combustion calculations, the higher heat of combustion at constant pressure and 60 deg. F. is tabulated below for fuel oils and complex mixtures of pure hydrocarbons such as treated gasoline and chemically refined kerosene or other specially refined distillates. Lower heating values are also tabulated for convenience in use where required.

Heat Content of Flue Gases

Specific heat data from spectroscopic measurements were used as a basis for the calculation of heat content equations of nitrogen, air, carbon dioxide and water vapor. The heat content values above 80 deg. F. have been presented by R. C. H. Heck.[8] They were used as a basis as the calculation of heat contents above 60 deg. F. (It was found by comparison that variations among the data reported by various recent investigators were of such magnitude as not to affect the correlations presented here.)

Empirical equations were obtained for heat content above 60 deg. F. The relation is best given for each gas except water vapor by different equations for two different temperature ranges. For calculation of stack losses it was desirable to have the exponents of the temperature constant in each equation except that for air.

Carbon Dioxide:

$H = 1.715\ T^{1.34} - 4{,}160$, Max. error 800 $-4{,}000$ deg. R. = 1.1 percent (10a)

$H = 1.66\ T^{1.34} - 3{,}380$, Max. error 2,000 $-4{,}500$ deg. R. = 1.2 percent (10b)

Nitrogen:

$H = 1.050\ T^{1.34} - 2{,}210$, Max. error 800 $-4{,}000$ deg. R. = 2.5 percent (11a)

$H = T^{1.34} - 1{,}360$, Max. error 2,000 $-4{,}500$ deg. R. = 1.3 percent (11b)

Water Vapor:

$H = 1.327\ T^{1.34} - 3{,}030$, Max. error 800 $-4{,}500$ deg. R. = 1.1 percent (12)

Air:

$H = 2.060\ T^{1.16} - 2{,}850$, Max. error 800 $-4{,}000$ deg. R. = 0.9 percent (13)

An excellent comparison between the older specific heat data and those based on spectroscopic analysis can be found in the paper by Sweigert and Beardsly.[18] Most standard references on combustion still use the older data while this work is based on the modern data.

Table II—Heating Values of Liquid Petroleum Fuels at 60 Deg. F., Constant Pressure, in B.t.u. per Lb.

	Fuel Oils		Pure Hydrocarbons	
C/H Ratio	Lower (Net) H.V.	Higher (Gross) H.V.	Lower (Net) H.V.	Higher (Gross) H.V.
6.0	18,640	20,000	18,640	20,000
6.2	18,540	19,860	18,540	19,860
6.4	18,430	19,720	18,440	19,730
6.6	18,320	19,570	18,350	19,610
6.8	18,210	19,420	18,270	19,490
7.0	18,110	19,280	18,190	19,370
7.2	18,010	19,150	18,120	19,270
7.4	17,910	19,030	18,050	19,180
7.6	17,840	18,910	17,980	19,090
7.8	17,720	18,800	17,920	19,000
8.0	17,640	18,690	17,860	18,920
8.2	17,570	18,590	17,810	18,840
8.4	17,500	18,490	17,760	18,770
8.6	17,430	18,400	17,720	18,710
8.8	17,360	18,310	17,680	18,650
9.0	17,300	18,230	17,640	18,590
9.2	17,240	18,150	17,600	18,530
9.4	17,180	18,070	17,570	18,480
9.6	17,120	18,000	17,540	18,440
9.8	17,070	17,930	17,520	18,400
10.0	17,030	17,870	17,510	18,370

Air Requirements and Excess Air

The following self-evident relationships between the mol fraction of CO_2 in the dry flue gas, the C/H ratio, and various other quantities, are important in combustion calculations, and follow directly from the definition of the C/H ratio.

Mols CO_2 per lb. of fuel $= \dfrac{R/12}{(R+1)}$ (14)

Mols H_2O per lb. of fuel $= \dfrac{R/2}{(R+1)}$ (15)

Mols of theoretical air per lb. of fuel $= [1/0.209]\,[(R+3)/12\,(R+1)]$ (16)

Mols of air per lb. of fuel $(M) = (R+3P)/12P(R+1)$ (17)

Fraction of excess air $(X) = [0.209R - P(R+2.373)]/[P(R+3)]$ (18)

The nomograph of Fig. 3 is based on Equations 17 and 18 on the assumptions of complete combustion and 100 percent hydrocarbon constituents. The error due to these assumptions rarely exceeds the accuracy of the basic measurements. Errors due to inaccurate C/H ratio values may be evaluated directly from the nomograph of Fig. 3. The magnitude of these errors is discussed in the introduction.

Multistage Molecular Still

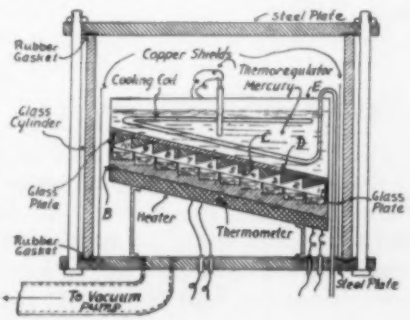
A new and highly efficient type of multistage molecular still has been announced by the National Bureau of Standards. Although the still was developed to separate the isotopes of mercury, plans are now laid for using it to separate pure hydrocarbons from petroleum and to isolate vitamins from animal and vegetable products.

As a type, molecular distillation is distinguished by operation under very high vacuum and by the location of a condensing surface only a few centimeters from the evaporating surface. Under these conditions it is possible to effect a separation of any mixture of high boiling substances if the components differ in molecular weights, the lighter molecules being more readily evaporated. Molecular distillation has been particularly useful in the separation of organic materials that do not differ appreciably in vapor pressure (boiling point) or are unable to withstand the high temperatures of ordinary distillation.

Prior to the design just revealed by the Bureau there has been no report of anyone's producing a molecular still with more than a very few number of stages. Separation was accomplished by the cumbersome process of running a succession of fractionations. In contrast, the still shown in the sketch has ten stages, and gives in one operation a separation that would have required 55 individual and recombination distillations. The new still consists of a "stairway" of evaporating surfaces, or pools, each with a cooled roof directly above it to condense the vapors. The roofs are sloped so that condensate runs along the surface and drops into the next cell higher up. A spillover in each pool lets liquid run back in amount equal to the condensate carried forward. The light fraction concentrates toward the upper end of the cascade, the heavy fraction toward the lower end. For the mercury still shown, the pools were made 2 cm. wide, 75 cm. long, and 0.8 cm. deep on the shallow side.

Chief advantages of the new still over a single-stage still are: Time, labor and materials are saved. Operation can be continuous. Material can be fed into either end or, if both heavy and light fractions are valued, at the midpoint. Air can be excluded from the entire separation, which is important with liquids that are decomposed by exposure to the atmosphere.

Vertical section through Bureau of Standards' new type molecular still. It may be the answer to molecular distillation's need for a multistage device



EDITORIAL VIEWPOINTS

Sidney D. Kirkpatrick and Staff

OUR SOUTHWESTERN EDITOR

JACK HIGHTOWER's transfer from Washington to Houston and the opening of an editorial office in the Merchants and Manufacturers Building in that city is part of our long-time program for increasing service to *Chemical Engineering* readers in this rapidly growing sector of our industrial economy. Jack is a native Texan, a chemical engineering graduate of its State university with broad knowledge and experience in its major industries. His wartime services in Washington, with the Petroleum Administrator for War and since 1945 with the McGraw-Hill News Bureau, has brought him into intimate touch with the informational needs of chemical engineers and executives. He takes over his new assignment with the earnest desire to help in the chemical engineering development of the great Southwest through more intimate personal contacts with its process industries and, in turn, reflecting and interpreting their progress for *Chemical Engineering's* growing readership throughout the world.

SIX MONTHS TOO LATE

NITROGEN shortages during next year are again being discussed by the U. S. Department of Agriculture as they consider the fertilizer program. It is pointed out in their March estimates that there will be a deficiency of 75,000 to 150,000 tons of nitrogen, if recent record demands of farmers are renewed next year, as seems likely. The final figure of scarcity will depend more than anything else on final decisions of the Army as to nitrogen exports for the occupied areas.

Nitrogen scarcity this spring was caused by the fact that the Department of Agriculture started its worrying about six months too late. It is hoped that preparation of the present estimates will be followed by suitable administrative action to keep military interference from again making nitrogen more scarce than it should be.

Already the Army has cut back production at arsenals by closing down Missouri Ordnance Works and cutting back production at Morgantown. It seems logical to suggest that the Department of Agriculture had better look into these matters promptly, so that next winter when it will be too late to correct matters, we shall not again discover a serious springtime shortage in prospect.

TIRED OF BLIND FLYING?

Do you realize that not since 1939 has this country had a complete census of its manufactures, of its mineral industries and of business as a whole? To be sure, those of us in the chemical and most of the process industries got along fairly well during the war on spot samples and piecemeal surveys that dealt with specific commodities. But we all have to go back to 1939 for our real benchmarks to which to tie together plans for production and distribution, market and investment analyses, regional studies and decentralization programs. Too many guesstistics and guesstimates are involved. It is time we all get behind sound legislation authorizing the Census Bureau to do the kind of a job that is necessary to serve not alone the interests of business and industry, but of the entire national economy that is dependent upon factual information for its efficient operation.

Companion bills (HR. 1821 and S. 554) were introduced respectively in the House and Senate by Representative Harold Hagan (R-Minn.) and Senator Albert W. Hawkes (R-N. J.). They are substantially identical to similar legislation which was proposed in the 79th Congress and failed of passage by a close vote. This must not happen again. You can help get these bills out into the open for hearings and report if you will write your views to Senator William Langer and Congressman Edward H. Rees, chairmen, respectively, of the Senate and House committees on post office and civil service.

TEACHERS FOR TEACHING

PRESIDENT Raymond B. Fosdick of the Rockefeller Foundation stated in his annual report that "The increasing availability of money for research in medicine is beginning to embarrass our medical schools." This agrees exactly with our observations in the engineering and physical-science divisions of important universities. There is so much federal money for support of research that the mere job of teaching tends to be neglected. As we pointed out in our editorial foreword last month, this is a matter of deep concern to all who have the long-term good of research at heart.

It now seems as though the big job for the support of research is to get funds to support *teachers for teaching*. It may well be that the Federal Government in establishing a National Science Foundation, if it does that as it should, will find that the big job is to re-establish the bases for training of research workers at both undergraduate and graduate levels. Certainly the lack of trained brain power is the most serious single factor in the future of research in America.

HOBSON'S CHOICE

MANY industrialists have argued that German enterprise should be forever forbidden to make products which might be competitive with those which we want to make in the United States for export. Lately there appears an argument which seems a bit persuasive in urging a change in that attitude.

Process industry can reasonably stand on the claim that it should not have to compete within the United States or nearby export markets with chemicals and other products of process industries made by subsidized German enterprise and transported here. But we must expect that German manufacturers are going to make more and more chemicals and other products of process industries as coal, steel, and essential raw materials are again available. They must do this to supply German activities. They must be allowed to do this in part also to supply their neighbors, in exchange for food and raw materials needed in Germany.

Unless we take such an attitude favoring the renewal of essential German enterprise, we must look forward to an unending period during which we shall have to support a pauperized German population. Purely on a basis of enlightened selfishness we should encourage the reestablishment of some essential chemical business in Germany. We must do this or we must be prepared indefinitely to provide the dole for millions of European paupers. But after we do so, we can of course demand also that such enterprise be supervised and controlled to keep it from becoming part of a re-militarized Germany.

DATA FOR BOSS-PICKERS

One of Phil Swain's "New Proverbs for Young Engineers" (see pp. 98-99) says something about picking the right boss and then proceeding to make life easier for him. Now, to make things easier for the boss-pickers, more than a hundred large employers of engineers have cooperated with the Engineers Joint Council in baring their innermost secrets and policies "pertaining to the selection, training, placement, advancement, guidance and professional activities of engineering graduate employees." Some of their statistics may be hard reading for other employers, but they are worth studying as datum points in the increasing competition for technical manpower.

These 104 cooperating employers represented 19 fields, including the colleges. Collectively they employ more than two million persons, of whom 40,000 or 2.0 percent are engineering graduates. Ranked on this basis, the instrument manufacturers top the industry list with 6.6 percent of their employees as engineers. Electrical manufacturers follow with 5.1 percent, then, petroleum with 4.9, chemical with 4.2 and aircraft (as of last August 1) with 3.9 percent. A middle group contains machinery and building construction with the over-all average of 2.0 percent, paper 1.8, glass 1.5, utilities 1.4, metals 1.4 and coal and coke with an even 1.0 percent. The lowest group begins with textiles at 0.9, followed by soap with 0.8, rubber 0.7, automotive 0.6, shipbuilding 0.6, transportation 0.5 and food with 0.3 percent.

It is significant—or is it?—that more than half of the first two groups feel that there are increasing opportunities for advancement by graduate engineers to executive positions. In these companies 42 percent of the executives and 37 percent of the officers are engineering graduates.

On the moot question of how many additional engineers will be needed during the next four years, the returns average out an annual increase of about 8 percent of the present engineer employees—a total of 31 percent by 1950. This is but half of the estimate of 17 percent per year reported by the Compton Committee which six months earlier in 1946 had contacted 125 companies employing 25,556 engineers. Whether or not this difference in forecasts was due to the timing of the request or the size of the sample is not evident from the preliminary report at this time.

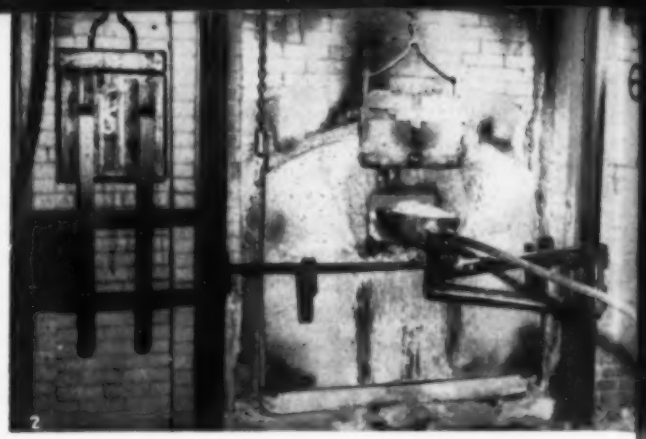
Who are hired? Ninety-six percent of the companies employ cadet engineers directly from the schools but only 4 percent recruit their engineering staffs exclusively from new graduates. About 43 percent hire more than half of their new engineer employees after one or more years' experience with other employers. This is evidently a matter of necessity or expediency because 60 percent of those reporting said they preferred to hire new graduates.

How are young engineers recruited and hired? Seventy percent of these employers regularly send their scouts to the engineering schools for preliminary interviews with candidates and discussions of their qualifications with faculty members. More than half invite selected students to visit their plants at company expense. About 75 percent rely chiefly on personal interviews between the candidates and their engineering executives although 20 percent employ aptitude or other tests for evaluating the applicants' abilities. Rating in order the bases on which engineering employees are selected, we find the following: (1) personality, (2) scholastic record, (3) indicated promise of development in specific fields, (4) engineering experience, (5) evidence of ability to cooperate with others, (6) recommendations by qualified people, (7) indicated promise for executive development, (8) standing of college from which candidate was graduated, (9) salary requested.

Although starting salaries appear to be the least important consideration as far as these 104 employers are concerned, it is evident from the report that there is no unanimity in their offerings. No company reports a starting monthly salary of less than $150 and only four less than $175. Five companies report starting salaries above $250, while the median (50 percent level) is approximately $207.

But what about raises? Here only 26 of the cooperating companies (from 12 different industries) supplied data but 76 percent reported that periodic reviews were made to determine salary increases on a merit basis, while 24 percent were guided chiefly by the recommendations of superiors. Of those who gave figures, the cumulative percentage increases from $207 median were as follows: After six months 8.0 percent; after a year, 14.6 percent; after eighteen months, 24.2 percent; and at the end of two years, 29.2 percent.

Such then was the situation in the manpower market late last summer. Has it gotten better or worse? What are the reports from your scouts who are contacting the sources of supplies? This preliminary report, it seems to us, strongly emphasizes the need for a continuing survey. It also piques our interest in the forthcoming report of the E.J.C. Committee on Survey of the Engineering Profession. Inquiries and requests for further information on this subject should be addressed directly to the Secretary, Engineers Joint Council, 25-32 West 39th St., New York 18, N. Y.



Pot and stirring thimble being moved from preheating furnace (1) to melting furnace where pre-mixed charge is added (2)

Optical Glass Production

C. H. HAHNER

Chief, Glass Section, National Bureau of Standards, Washington, D. C.

Optical glass has been developed and produced by the National Bureau of Standards since World War I. In normal times only a small quantity is made, but as much as 250,000 lb. was produced for military use in a single year of World War II. New types were developed and methods used in production have been improved.

SPECIAL grades of glass are required for the optical elements of such precision instruments as telescopes, microscopes, interferometers, spectroscopes and range finders. In addition to possessing a required index of refraction within a very close tolerance, the glass must be chemically and physically stable, highly transparent, colorless, homogeneous and free from flaws. Two of the most common defects are "seeds" and "striae." Seeds are small bubbles of gas trapped in the molten glass. Striae are fine threads of glass of composition slightly different from the main body and therefore of different refractive index. Both defects are present to some extent in practically all optical glass and when excessive they interfere with performance. Beginning with raw materials of the highest purity and continuing until the glass leaves the plant, careful planning and extreme care in each step of the manufacturing operation are required.

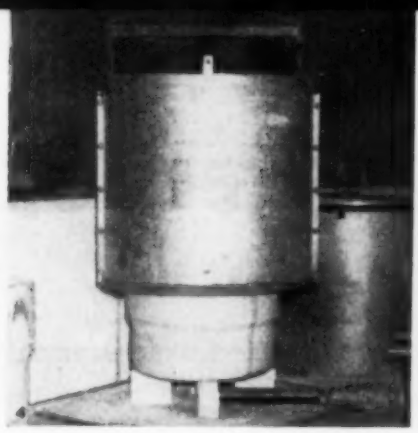
Special Pots

Pure glass requires pots that will resist attack from the molten glass and will not introduce impurities through interaction with the glass. The highest quality optical glass is made in pots that are used only once. Pots are made up of four chief constituents: feldspar, ball clay, kaolin, and old pot bodies. For the more corrosive glasses, a dense low-porosity lining is added. Cast in plaster of paris molds by the process known as slip casting, they are removed from the molds as soon as they have dried sufficiently to handle, air-dried for several weeks, then fired up to the melting temperature of the glass they are designed to hold. At the time the pots are made, stirring thimbles are prepared from the same material and submitted to the same treatment.

Batch Mixing

Great care must be exercised in preparing the batches so that the glass will be of correct composition and index of refraction. Any glass which is "off index" must be discarded. Purity of the materials must be determined frequently. If the materials have absorbed water, this must be considered when preparing the batches and necessary corrections made. Potash, soda ash and saltpeter may change significantly in water content. Borax when stored

Large chunks are sawed to size convenient for molding (6), then softened in furnace and gathered on "pontil rod" (7)



Stirring mechanism in operation (3). Removed from furnace, pot cools under insulated jacket (4), is then broken open (5)

in a heated room may lose some water of hydration. When changes in the melting schedule are made, an estimate of how these changes will affect the volatilization of constituents such as K_2O, Na_2O, B_2O_3 and PbO must be made and corresponding corrections made.

Each batch is individually weighed and mixed, and to discount any incompleteness of mixing, all the batch is used in one pot. Individual batch constituents are weighed to an accuracy of 0.5 lb. So far as possible, materials of the same grain size and density are used in order to obtain a well mixed batch. Batches, which weigh from 1,000 to 2,000 lb., are mixed in a drum type mixer equipped with baffles, similar to an ordinary cement mixer. "Holdback" in the mixer by caking of the materials on the drum or baffles must be avoided.

Melting

A well defined procedure and fairly close schedule are followed in the melting of a pot of glass. The pot is placed in the melting furnace and brought to the melting temperature of the glass it is to hold. The charge of batch and cullet (waste glass from previous melts of the same composition) is then introduced. Capacity of the pots is approximately 7 cu.ft. and the time necessary to fill them varies from 5 to 10 hr.

After foaming has subsided the melt is stirred with a thimble held in place and driven by a water-cooled metal rod. As soon as the molten glass is reasonably free of seeds, it is gradually cooled in the melting furnace, with decreased rate of stirring, until the viscosity increases to the point where further stirring would ruin the glass. The temperature at which this occurs is critical and may vary from 950 to 1,100 deg. C., depending on the type of glass. When the pot is removed from the furnace, it is covered with a thermally insulated jacket so the glass will cool slowly enough to break into fairly large chunks. Breaking open the pot completes the first stage of production.

Shaping

Other major steps that follow are trimming, molding, annealing, and several inspections. Visible imperfections are trimmed from the rough chunk with steel hammers or diamond saws, and the chunks are broken or sawed to a convenient size for molding into blanks. Molding procedure varies according to the size of the blanks, but for all except the largest, molding is by hand.

The rough pieces are heated gradually in a preheating furnace to a temperature just below the softening point and are then picked up on the end of a steel rod known as a "pontil" rod. Heated well above their softening point in a molding furnace, they are worked into the proper molding shape. The shaped and correctly heated piece of glass is cut off with shears, dropped into a steel mold, and pressed into shape. Another molding procedure is known as paddling. The rough pieces, instead of being picked up on the pontil rod, are placed in a paddling furnace, worked into approximate shape with metal paddles, transferred to a metal mold and pressed. Blanks too large to be worked by hand are placed in a ceramic mold and heated gradually until they soften and flow into the shape of the mold. Removed from the mold, the blanks must be cooled slowly to prevent cracking.

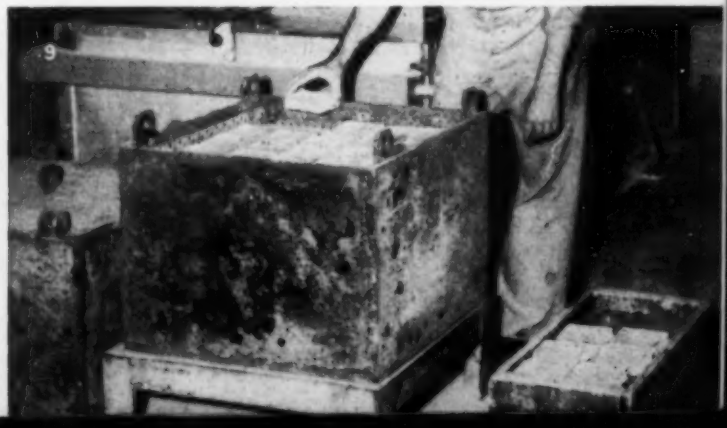
On cooling, the molded blanks are inspected. Immersed in a liquid having an index of refraction similar to that of the glass, the glass surfaces disappear and imperfections in the interior become evident under proper illumination.

Annealing

As glass solidifies, strains are set up which seriously affect the optical and physical properties of the glass and must be removed by annealing. The glass is heated to a temperature somewhat below its softening point, held there long enough to remove strains and obtain a uniform index, then cooled slowly.

Before grinding and polishing, a final inspection for strains is made. Again immersed in a liquid of correct index, the blanks are examined with polarized light for interference figures. About one month elapses between mixing of the batch and completion of a finished blank, ready for grinding and polishing into an optical element.

Soft glass is snipped off into steel mold (8) to be pressed into blanks, which are placed in metal case for annealing (9)



THE PLANT NOTEBOOK

Theodore R. Olive, ASSOCIATE EDITOR

$50 CASH PRIZE FOR A GOOD IDEA!

Until further notice the editors of *Chemical Engineering* will award $50 cash each month to the author of the best short article received that month and accepted for publication in the Plant Notebook. The winner each month will be announced in the issue of the next month: e.g., the April winner will be announced in May and his article published in June. Judges will be the editors of *Chemical Engineering.* Non-winning articles submitted for this contest will be published if acceptable, in that case being paid for at applicable space rates.

Any reader of *Chemical Engineering,* other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible. Neither finished drawings nor polished writing are necessary, since only appropriateness, novelty and usefulness of the ideas presented are considered.

Articles may deal with any sort of plant or production "kink" or shortcut that will be of interest to chemical engineers in the process industries. In addition novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address Plant Notebook Editor, *Chemical Engineering,* 330 West 42nd St., New York 18, N. Y.

MARCH WINNER

A $50 prize will be issued to

F. A. MITCHELL
Evans Chemetics, Inc.
Waterloo, N. Y.

For an article describing a simple portable, ventilated "tunnel" for discharging noxious, molten kettle contents that has been judged the winner of our March contest.

This article will appear in our May issue. Watch for it!

February Contest Prize Winner

AIR OPERATED FEEDER FOR SMALL FLOWS OF POWDERS AND GRANULATED SOLIDS

ALFRED H. McKINNEY
Chemical Engineer
Philadelphia Quartz Co., Philadelphia, Pa.

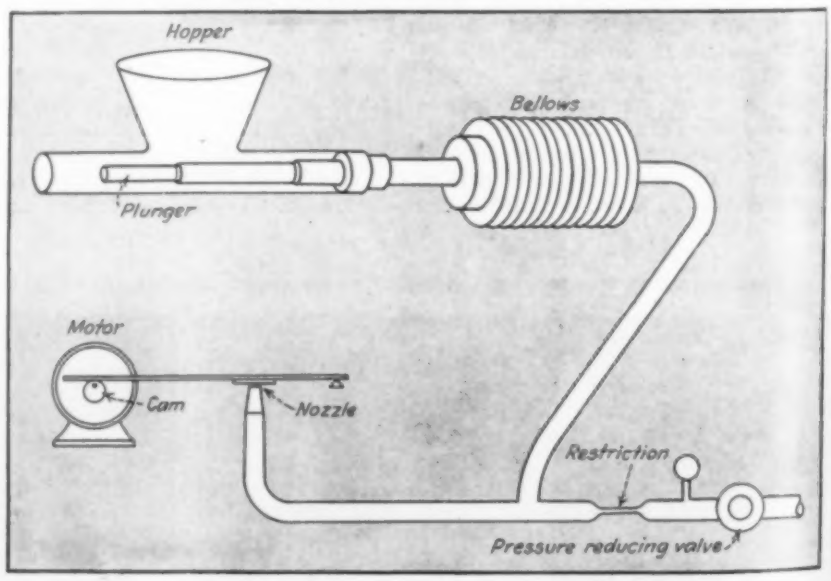
ONE SOLUTION to the problem of feeding powders or granular material at controlled rates is shown in the accompanying diagram. Air at constant pressure passes through a constriction to a bellows which alternately expands and contracts, operating a plunger. The air pressure change is caused by a 4 r.p.m. synchronous motor driving a cam which alternately closes and opens a nozzle. The plunger is soldered to a 2-in. extra flexible bellows and travels about 1 in. for a 10 lb. change in air pressure. It was turned down on a lathe stepwise to decreasing diameters towards its tip and thus was able to move the solids through several inches of travel in the tube below the funnel. Asbestos cord, cemented with sealing wax, provided sufficient packing between the tube and the plunger.

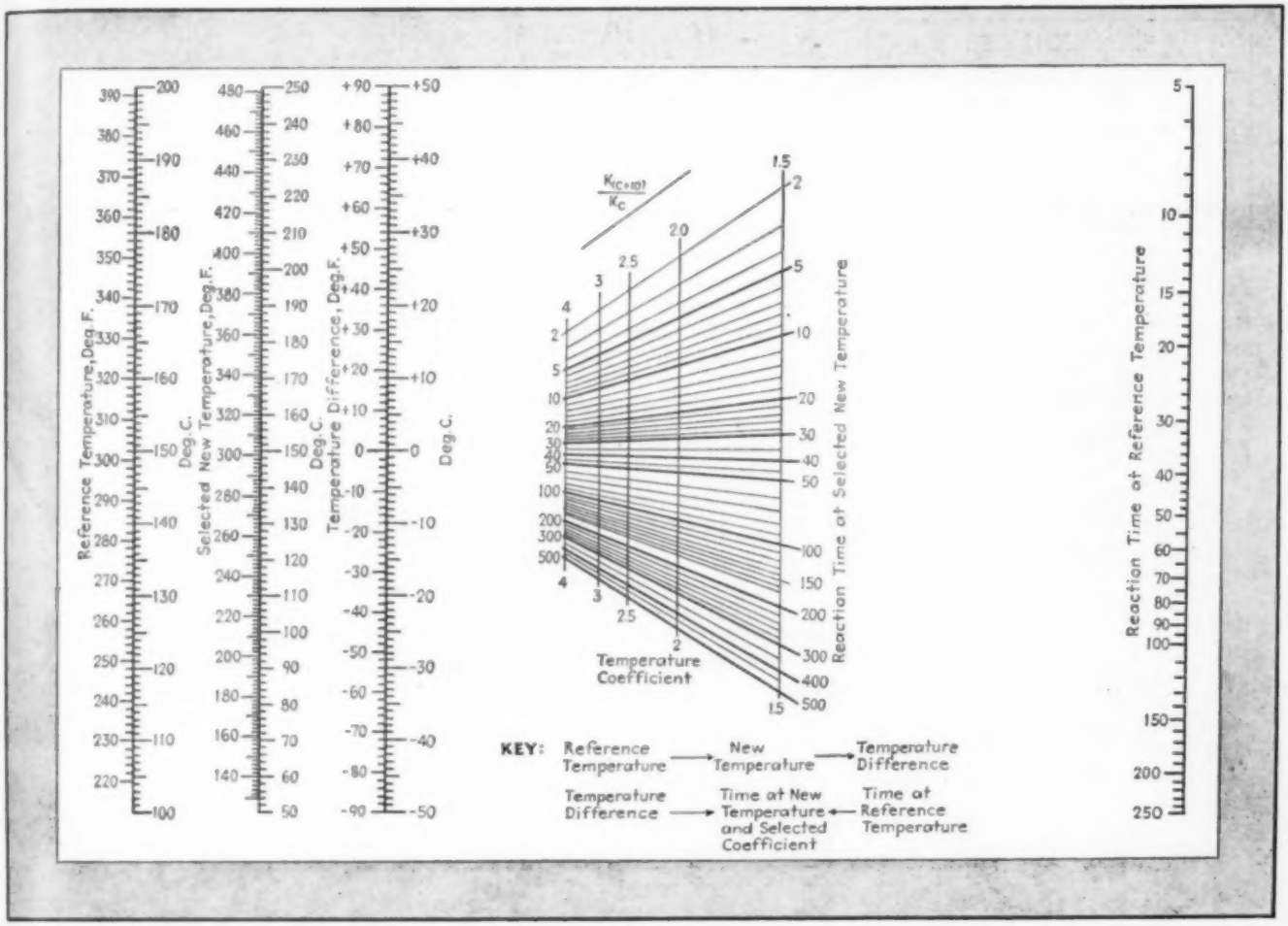
The rate of feed can be changed to any desired value by adjusting the air pressure. The range of the device can be changed by replacing the synchronous motor with one having a different speed, such motors being readily available over the range 60 r.p.m. to 1 r.p.d. The feeder should respond well to automatic control; a pneumatic system would regulate the air supply, or an electrical system would change the motor speed. For difficult control problems, such as pH, both could be used —the air pressure being controlled proportional to one variable such as the flow to be neutralized and the motor speed being controlled by the primary measurement. Small pneumatic motors can be used for all pneumatic systems.

This device was built for about $17, the parts including the synchronous motor, $4; a 2-in. bellows, $8; and a pressure regulator, $5. Labor was 4 man-hr.

(*Editor's Note:* Not much change would be needed to use the same idea for a controllable liquid pump.)

Bellows operated pneumatic feeder for solid materials




Reference Temperature, Deg. F.
Deg. C.
Selected New Temperature, Deg. F.
Deg. C.
Temperature Difference, Deg. F.
Deg. C.
$\frac{K_{(C+10)}}{K_C}$
Temperature Coefficient
Reaction Time at Selected New Temperature
Reaction Time at Reference Temperature
KEY: Reference Temperature → New Temperature → Temperature Difference
Temperature Difference → Time at New Temperature and Selected Coefficient ← Time at Reference Temperature

Nomograph solves for new reaction time when temperature coefficient is known and reaction temperature is changed

CHART FOR CALCULATING REACTION TIME CHANGES

JOHN G. HARRISON, Jr.
National Automotive Fibres, Inc.
Trenton, N. J.

and

WILLIAM E. SETZLER
Vulcan Proofing Co.
Brooklyn, N. Y.

USE OF the concept of a temperature coefficient of chemical reactions is a practical and workable tool in both laboratory research and engineering practice. Calculations involving temperature coefficients are not always as simple as the general rule: "A 10-deg. Centigrade temperature increase will double the reaction velocity." The nomograph presented in this paper treats the temperature coefficient as a variable number as has been reported in the literature for different reactions. Without such treatment the formula involved is unduly limited. In removing this limitation, the authors have designed the nomograph so that it possesses maximum simplicity and accuracy.

A discussion of kinetic theory is not in order at this time, but the authors wish to point out that temperature coefficients may be properly used more often than strict chemical kinetics will allow. In fundamental investigations of chemical kinetics, the calculation of activation energies frequently affords a better approach than the one under discussion.

In factory operations the characteristics of a chemical reaction are rather well known, and it is recognized that other factors such as rate of heat transfer affect reaction times. For practical purposes such factors are grouped under considerations of the necessary over-all temperature and time to complete a reaction. Generally, operating conditions are not greatly changed for

PROGRESS REPORT ON ROAD HEATING

This roadway, which was shown in a construction view on page 122 of our December 1946 issue, is in the Bridgeville, Pa., plant of American Cyanamid Co. Its unique feature is that despite its slope, it cannot give trouble from snow and ice because it contains eight runs of water-heated wrought iron pipe, two under each wheel track of the 600-ft. long, two-lane driveway. The view was taken shortly after a snowfall to show how quickly the system operates. A small heat exchanger connected to the plant boiler supplies water at 140 deg. F. This is to be increased to 165 deg., however, for still faster operation.

CAN YOU USE

A little extra cash from time to time? If so get that Plant Notebook idea down on paper and send it in! If it doesn't win the $50 monthly prize it may still be worth a nice check at regular space rates.

the same reaction. The most usual factory problem in changing operating temperatures is to have the chemical reaction proceed to some definite degree of completion, the change in temperature being compensated for by a change in reaction time. Under the influence of moderate changes in temperature the effect of decreasing temperature coefficient with increase in temperature is not generally noted.

In its strictest application the temperature coefficient is the ratio $K_{(t+10)}/K_t$ where K_t is the velocity constant at a definite temperature, deg. Centigrade, and $K_{(t+10)}$ is the velocity at a temperature 10 deg. C. higher. Reaction total time is an integral quantity of the reciprocal of rates and the quantities treated in the nomograph are more generally understood in the following form:

$$T_1 = T_2 \times C^{\left(\frac{Te_2 - Te_1}{10}\right)}$$

or

$$\text{Log}\,\frac{T_1}{T_2} = \left(\frac{Te_2 - Te_1}{10}\right) \text{Log}\, C$$

where Te_1 is a definite Centigrade temperature corresponding to a definite time T_1; and Te_2 is a new temperature which will require a new reaction time T_2 for a definite temperature coefficient, represented by C.

The nomograph as presented consists of two parts which may be used separately according to the key given with the chart. The lefthand side of the nomograph consisting of the first three lines on the left is a set of subtraction scales using either Fahrenheit or Centigrade temperatures to solve for the temperature difference by the use of the customary straight line. In the use of the grid part of the nomograph the line representing the temperature coefficient of 2.0 will probably be used most, but a few selected other temperature coefficients have been included. A straight line connecting "temperature difference" with "time at a reference temperature" will solve for a new reaction time at a selected temperature coefficient.

It should be noted that any temperature coefficient can be represented by a vertical line placed properly on the chart. The position of such a line on the chart may be found by the following formula:

$$d = D\left(\frac{1.699}{1.699 + 10\ \text{Log}\ C}\right)$$

where d is the horizontal distance to the right of the line "temperature difference," at which distance the line representing a definite temperature coefficient C should be drawn; and D is the total horizontal distance between the line representing "temperature difference" and the line representing "reaction time at reference temperature."

The nomograph presented will solve rapidly the problem of selection of new reaction times and temperatures when the temperature coefficient is known. Compared to other methods of calculation, the use of the nomograph to determine the actual temperature coefficient from sets of rate and temperature data is extremely rapid.

The solution of these problems by the method suggested above is particularly applicable to lengthy reactions, such as the manufacture of organic chemicals, the synthesis of resins, and the vulcanization of rubber.

CONDENSER BYPASS IMPROVES TOWER PRESSURE CONTROL

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IN FRACTIONATING TOWERS which are operated with total condensation of the overhead it is customary to control tower pressure indirectly by controlling condenser coolant flow. It has been found that in such cases condensers cooled by circulating water are subject to severe fouling and corrosion by dissolved oxygen. This has been attributed to stagnation and the high temperature of the exit water caused when the condenser water flow is controlled at low rates to satisfy required condensate temperature, i.e., tower pressure. Such a condition may result from condenser overdesign as well as operation at low process flows.

The following arrangement, which incidentally gives more stable pressure control because of the absence of the capacity lag, is proposed to maintain a minimum exit condenser water temperature and a maximum velocity of water through the tubes. (It is recognized that inhibitors may also be used to reduce oxygen corrosion.) Condenser water is allowed to flow at a maximum rate while tower pressure is controlled by bypassing overhead vapors to the condensate receiver in such amounts as to effect the required condensate temperature. The bypass is automatically controlled through the medium of tower or receiver pressure. The proposal is illustrated in the accompanying sketch.

The liquid seal h_1 guarantees a definite minimum pressure drop for operation of the control valve and a definite maximum pressure drop $[h_2 + h_3 + (P_1 - P_2)]$. The tie-in should be designed to give good mixing of cooled condensate and bypassed vapors.

To estimate the control valve size the following is considered in setting maximum and minimum conditions: Let t_1 = subcooled condensate temperature; t_2 = controlled condensate temperature; x = condensate rate; y = bypassed vapor rate; L_v = latent heat of vaporization; C_p = average specific heat; P = pressure; and $P_1 - P_2$ = pressure drop through condenser.

Then:

$$x\,(t_2 - t_1)\,C_p = y\,L_v$$

or

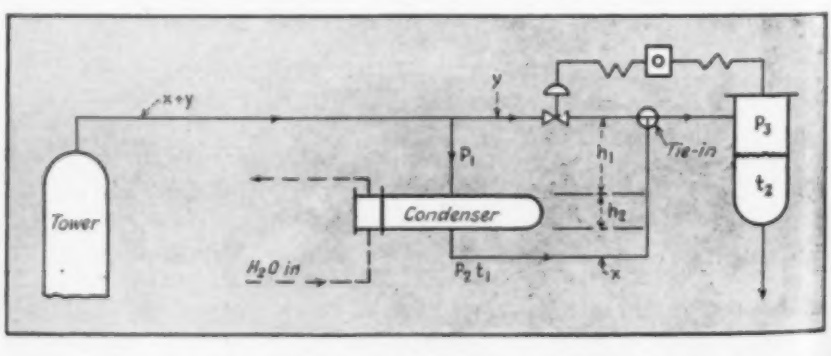
$$\frac{x}{y} = \frac{L_v}{(t_2 - t_1)\,C_p}$$

where

$x + y$ = Total overhead flow from tower.

At a minimum overhead rate $x + y$ the condenser approaches complete flooding, t_1 approaches inlet water temperature and control valve available pressure drop is h_1. As $x + y$ is increased, the liquid level in the condenser drops, giving a greater available pressure drop $h_1 +$ for value operation. However, t_1 begins to approach t_2 and the required y approaches a maximum, then reduces to 0. It is recommended that an automatic reset instrument be specified for control valve operation.

Condenser hookup for improving tower pressure control



REPORT ON . . . .

Recent Developments in FUEL TECHNOLOGY

Although the subject of fuel reserves and fuel interchangeability is not new, it has taken on new meaning. This has long been a subject for speculation but, since the end of the war, the possibilities for building an American synthetic fuel industry seem to approach economic reality. While a good deal of controversey exists over the subject, most impartial persons are withholding judgment until the proposed Brownsville plant for making gasoline from natural gas has been successfully operated. Regardless of the outcome of individual efforts, however, the enormous amount of research being poured into this work by the oil industry, the coal industry and the government should result in processes that will make economically possible the complete interchangeability of fuels.

CONCERN shown over the future of petroleum is not surprising. It is the natural aftermath of a period of excessive consumption, and the alarm expressed over "dwindling" oil reserves is not unlike those sounded many times since oil became a major commodity in the daily lives of the American people. Regardless of whether they are justified or not these predictions have served to bring about an increasing awareness of the fact that oil supplies are not inexhaustible and that the future requirements for liquid fuels must depend on pooling the nation's fuel resources to overcome the lopsided drain on oil reserves.

But what is there about the present fuel situation that makes it different? Why is it that fuels, so commonplace and so basic to American economy, are taking the spotlight in the technical press as well as in the newspapers and national magazines? From every quarter comes headlines concerning Fischer-Tropsch, underground gasification of coal, gasoline from natural gas and gasoline from coal. Can it be a flurry that will die down as the nation sinks back to a peacetime economy or is it the beginning of a new fuel technology?

At the root of the problem seems to be the underlying need for (1) fuels in liquid form to feed the automobile, airplane, locomotive and other mobile vehicles and (2) the increasing tendency of both industry and householder to use liquid and gaseous fuels instead of coal. The basis of any change will be economic, but it is more than that, it is a way of life. Maintaining the standard of American living, in fact, maintaining national security, rests on improving the utilization of natural resources. Consequently, an examination of fuel reserves and the technology and economics of their utilization should help in evaluating the present trends.

Certain facts stand out. Basic costs of crude petroleum are rising due to the increasing costs of finding new oil and the increasing cost of getting it from the ground. Only the discovery of vast new fields could change this situation appreciably and, while possible, this is not likely. Imports, which depend on national and world politics, would keep prices down but national security dictates the development of American resources. Increasing prices invariably lead to renewed competition from other fuel sources.

Advancing Technology

Equally important is the advance in technology which now appears to make feasible the further utilization of the vast resources of coal and the relatively untapped sources of natural gas. Pioneered in Germany under the conomics of aggression, processes were successfully developed to convert coal to oil and chemicals. Starting where the Germans left off, American chemists and chemical engineers are bending their efforts to utilize the processes developed in that country.

Most important of the German de-

velopments is the Fischer-Tropsch process for synthesizing hydrocarbons from carbon monoxide and hydrogen. Modified and redesigned to take advantage of fluidization techniques this process is being subjected to a program of research and development of the same order as was carried out in developing the catalytic cracking processes just a few short years ago. This, plus the development of processes for making cheap oxygen (see *Chemical Engineering* Reports for January and March 1947) is expected by many to lead the way to a real synthetic liquid fuels industry.

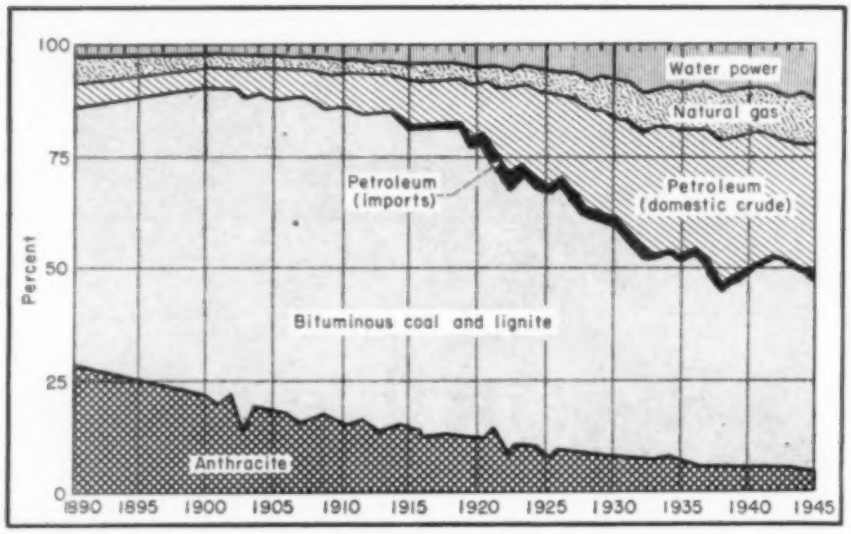
Undoubtedly the soundness of such a program will depend on the success of the projects now under way. Indeed the most impressive evidence of the necessity for a synthetic liquid fuels program is the fact that it is being carried out on such a large scale and is being financed to a large extent by major oil companies.

A number of projects are now under way for the purpose of producing oil from natural gas and coal. While the oil industry as well as the U. S. Bureau of Mines has investigated methods to supplement petroleum resources, most of the projects stem from German developments. Far ahead of the rest of the world in this respect, Germany's lack of natural oil stimulated its work of developing synthetic oil. Starting in 1926 by building a Bergius plant for direct hydrogenation of coal to oil and in 1933 with a Fischer-Tropsch plant for converting coal produced water-gas to oil, that country by mid-1940 had an annual synthetic oil capacity of over 16 million bbl. from around 20 plants.

The Current Picture

First notice that oil synthesis was considered a commercial possibility in the U. S. was the announcement, shortly after the end of the war, of plans for construction of a plant near Brownsville, Tex., to convert natural gas into oil by the modified Fischer-Tropsch process developed by Hydrocarbon Research, Inc. Estimated to cost over $15,000,00, this plant, designed also by Hydrocarbon Research and to be erected by Arthur G. Mckee & Co. of Cleveland, will be financed and operated by Carthage Hydrocol, Inc., (a new firm composed of a group of eight companies of which the Texas Co. is the major stockholder).

Some 64,000,000 cu.ft. per day of natural gas will be processed to yield 5,800 bbl. of gasoline, 1,200 bbl. of diesel oil and 1,200 bbl. of crude alcohols in water solution. Estimated costs are that gasoline made at this plant will



Percentage of total B.t.u. equivalent contributed by the several sources of energy in the United States (U. S. Bureau of Mines)

be 5¼c. per gal. which compares favorably with the present Gulf Coast wholesale price of 7½c. per gal. While such cost estimates have been widely discussed and have caused a good deal of controversy, there seems to be no doubt that synthetic oil is coming closer than ever before to economic reality. The Brownsville project is considered by many as a demonstration plant on a large scale and should prove the economics and technology of the process. To be put into operation in 1948, the outcome of this project will help determine whether or not similar plants will be built in the future.

While the work done by Hydrocarbon Research, Inc., has been most highly publicized, other organizations have carried on extensive research and development work as well. Included are Standard Oil Co. (Ind.), Standard Oil Co. (N. J.), M. W. Kellogg Co., Gulf Oil Co., Pittsburgh Consolidation Coal Co., and others. In fact, most of the major oil companies are interested and undoubtedly are carrying on extensive research projects.

The second of the Fischer-Tropsch plants is that of the Stanolind Oil and Gas Co. (subsidiary of Standard Oil Co. of Ind.) which will use 100,000,000 cu. ft. of natural gas per day to produce 6,000 bbl. of gasoline and 1,000 bbl. of distillate fuels at the Hugoton gas field in Kansas. This company, with no foreign holdings, has conducted extensive research and pilot plant studies in synthesizing gasoline from natural gas. Engineering work on this project is said to be in progress. The plant will be built by M. W. Kellogg Co.

Low production costs anticipated for both these plants, in comparison with German costs, are generally attributed to the production of cheap oxygen and to the use of fluid catalyst reactors with iron base catalyst in place of the small fixed bed cobalt catalyst reactors used by the Germans. Capital charges against the final cost of the product have been estimated to be about 50 percent and the raw material cost about 20 percent. Future plants should be lower in cost because of the experience gained in these pioneer plants.

The Standard Oil Co. (N. J.) has been actively working with the Fischer-Tropsch synthesis for some time and has had a pilot plant in operation for nearly two years. Having led the way in development of fluid catalyst cracking technique, this company has continued this work in the synthesis processes. Recently joined with Pittsburgh Consolidation Coal Co., the Standard Oil Development Co. is now applying its know-how to application of fluidizing technique to accomplish the complete gasification of coal to make Fischer-Tropsch synthesis gas. A $300,000 pilot plant will be built near Pittsburgh to carry on the work of developing an economically feasible process for making synthetic liquid fuels and coal. This same coal company is financing development work at Hydrocarbon Research Inc. on this same problem.

Aim of the coal company is to develop a process for making liquid fuels as well as a high B.t.u. gas which could compete with natural gas now entering the Pittsburgh area from Texas via the Big and Little Inch pipelines. Behind this work is the necessity for the coal interests to save their

own industry. It is only natural, then for this merger of coal and oil interests to occur since the possibility of interchangeability of fuel makes cooperation essential. Pittsburgh Consolidation Coal Co. was formed only recently by a number of coal companies. One of the reasons in back of its formation was to pool their research dollars to set up an effective program for research and development of new fuel processes.

Bureau of Mines

One of the most extensive programs in operation is that of the U. S. Bureau of Mines. In 1944 Congress passed a bill authorizing the expenditure of $30,000,000 over a five-year period for research and development on synthetic liquid fuels. Major projects are in progress on coal hydrogenation, shale oil production, Fischer-Tropsch process, and other similar projects. This research program is comprehensive and the demonstration plants should yield valuable data.

One recent project sponsored by the Bureau of Mines is the controlled underground gasification of coal. Carried out in a joint effort with the Alabama Power Co., the experiment is just the beginning of efforts to improve fuel production from coal. Several types of operation were studied and include continuous air blasting to manufacture producer type gas, alternate runs of air and steam for production of water gas and a short period of liquid oxygen injection. Because of the limited nature of this experiment, few conclusions have been expressed. However, it is felt that a promising start on a worthwhile project was made and undoubtedly this work will continue. A complete report of this experiment is given on pages 107-109 of this magazine.

The gas industry is conducting experimental work at the Institute of Gas Technology and investigation work is being done on several of the gasification processes used in Germany. One of the most important problems in the industry is that of peak load supply but many of the new processes are best adjusted to base load service. A two-stage gasification process is being developed for bituminous coal which softens and cakes under influence of high temperature gasification. Fluidization techniques and cheap oxygen enter this picture too. Considerable thought has been given to the gasification of anthracite which can be handled as a fluidized solid with no more trouble than low grade coals in Germany.

An important part of the coal industry research has been to develop better and more efficient equipment to burn coal. One such project is the coal burning gas turbine locomotives now being developed under direction of the Locomotive Development Committee of Bituminous Coal Research Inc. This and other developments should help coal retain some of the business it has been fast losing.

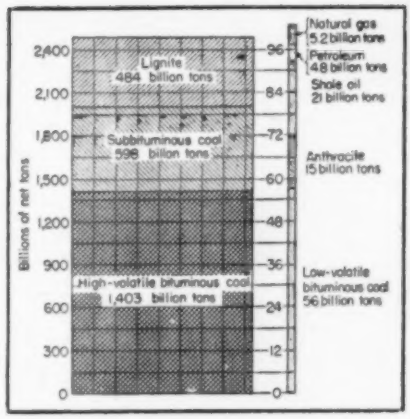
No discussion of basic fuel developments is complete without considering atomic energy. However, all work along these lines is under supervision and direction of the Atomic Energy Commission. (A comprehensive treatment of this work is given in *Chemical Engineering*, March 1947, pp. 96-100).

A brief review of the nation's fuel reserves and the trends of production, consumption and utilization should help explain the emphasis now being placed on synthetic liquid fuels.

Fuel Reserves

Petroleum—The rise of petroleum can be linked directly to the automobile industry. Forty years ago, only 8 percent of the mineral fuel energy consumed in this country was furnished by petroleum. This increased to 15 percent by 1920 and to nearly 30 percent by 1945. Petroleum production met all demands until the recent war period when transportation difficulties were a major factor behind fuel rationing. However, failure to discover new reserves in the middle 1920's caused serious consideration to be given to producing motor fuel from oil shale and coal. This apparent shortage was shortlived due to the development of geophysical methods of finding oil and to the techniques of deeper drilling. Discovery of the great East Texas pool increased reserves tremendously. Oil production more than doubled from about ¾ billion barrels in 1926 to a peak of 1.74 billion barrels in 1945. Wartime consumption is continuing undiminished, dropping only to 1.73 billion barrels in 1946.

The trend of new discoveries has been downward since 1939. Present proved reserves of 20.8 billion barrels are the largest ever established but are little more than 12 percent over the reserves of 1940. Proved reserves are only about 12 times the annual production. Whether this ratio can be maintained and for how long, is hard to tell. While reserves can probably be kept up for a considerable time, supplies aren't inexhaustible and recurring periods of emergency would cause severe drain. Most serious aspect of the situation of the past four years is that additions to reserves have mostly represented extensions and revisions of existing pools rather than the discovery of new ones.



Estimated mineral fuel resources of the United States as of Jan. 1, 1946, and expressed in equivalent tons of bituminous coal of 13,000 B.t.u. per lb. calorific value. Medium volatile bituminous coal is distributed between high and low volatile coal

Costs of exploration and prospecting have gone up and will continue to rise. New discoveries are more infrequent and the job of finding new oil is becoming increasingly difficult. Over 5,000 exploratory or wildcat wells were drilled last year, of which 80 percent were dry holes. Despite this intensive exploration, reserves in new pools found last year were less than a quarter billion barrels. Barring great new discoveries which might temporarily halt the trend, the maintenance of our present reserve to production ratio (if at all possible) is going to cost considerably more than it has in the past.

Production costs have also gone up. Much of the easily produced oil is gone—the cream has been skimmed—and a large number of oil fields formerly abandoned are now being reworked by up to date methods which permit greater recovery. Where 25 percent of the total oil was taken from the ground in the early days of oil, now nearly 75 percent recovery has been effected.

Higher price levels on crude oil improve the opportunity for synthetics to gain a foothold. On the other hand they lead the way to increased imports. One of the most important factors in crude prices is the possibility of large scale imports. Oil can be shipped to the Eastern Seaboard from the Middle East and sold at a lower price than if shipped from the Gulf Coast area. Undoubtedly the

government policy regarding imports and tariffs will be an important factor on the competitive price of crude. In any case, the availability of cheap foreign oil will prove a balance wheel against high domestic prices and should be considered when planning a synthetic liquid fuel industry.

Natural Gas—Proved reserves of natural gas of some 160 trillion cubic feet are somewhat larger, in terms of heating value, than the proved petroleum reserves. Ultimate reserves have been estimated at figures that vary from 200 to 300 trillion cubic feet. Natural gas is now produced at the rate of about 5 trillion cubic feet per year, on which basis the ultimate reserves will last some 50 years.

Gas Reserves

Most of the gas fields have been found in connection with the search for petroleum and some 55 percent of the natural gas produced and consumed in this country is produced in conjunction with oil. Although wastage has been high, especially where it is associated with petroleum in locations remote from industrial consuming centers, this has been cut down markedly in recent years. Even so, nearly ⅛ of the gross total production is listed as losses and waste. Treatment for production of natural gasoline results in large losses. One practical method of utilizing excess gas incidental to oil and natural gasoline production is to pump it back into the oil strata to increase the recovery of oil. Such repressuring and also the storage of natural gas in underground reservoirs prevent waste.

Liquefied petroleum gas has become a significant part of the output of the natural gasoline industry. Comprised principally of propane and butane, these materials are too condensible for high pressure transmission in pipelines and too volatile for motor fuel and have long been sold as bottled gas. Use of this gas has widened until it serves not only the consumer who does not have access to public utility gas but is utilized by public utility systems during peak load periods. Formerly wasted, L.P.G., as it is called, is now an important energy source.

Utilization of natural gas was boosted by building pipelines to consuming centers. Starting about two decades ago long distance pipeline distribution has been the most important factor in extending the usefulness of natural gas. Here again, this was made feasible and profitable by the development of dependable compressors and by pipeline welding technique.

Natural gas is now figuring heavily as a source for synthetic gasoline. Two of the Fischer-Tropsch plants now projected will synthesize gasoline from a synthesis gas made from natural gas. This is the first step in the effort to pool the national fuel resources and when successful will probably be applied to other gas fields that are remote from a consuming market. Such utilization will undoubtedly be influential in cutting down wastage. Since the gas supplies aren't unlimited, large scale conversion to liquid fuels will bring cries for conservation. According to estimates it takes some 11,000 cu. ft. of natural gas to make 1 lb. of gasoline via Fischer-Tropsch.

Oil Shale—Deposits of oil shale are estimated at 92 billion barrels of recoverable oil which amounts to a 50 year supply at present rate of consumption. Assay value of these shales which are located in the Rocky Mountain states varies from 15 to 60 gal. of crude per ton of shale. No commercial operations have been conducted on American shales but it is estimated by some that crude shale oil could be extracted at a price from $1.80 to $2.50 per bbl. Oil shale may prove to be an important supplementary fuel in the future but it isn't likely that it will compete in price with any synthetic fuels now visualized.

Coal Reserves

Coal—By far the most important fuel, both from the standpoint of reserves and volume consumption is coal. Total reserves are estimated at slightly less than 3.2 trillion tons which, at the present rate of consumption, will last over 2,000 years. Main consumers of coal are the railroads, coke ovens, public utility power plants, industrial use and space heating.

With the exception of certain industries such as steel, where coke is used primarily as a reagent, and for applications such as power plants, the trend in consumption has been strongly away from coal. Displacement of coal by liquid and gaseous fuels has risen sharply and despite the efforts of the coal industry to stave off the shift this trend will doubtless continue. Railroads, householders and industry move toward the greater efficiency and convenience of non solid smokeless fuels.

Meanwhile, the industry has seen its output drop from a war peak of 620,000,000 tons a year to about 550,000,000 tons. Though there is some disagreement, demand in 1948 will probably fall another 100,000,000 tons to a total of about 450,000,000 tons. The industry is in a position where it welcomes developments where new concepts of utilization will turn the trend upward.

In considering coal as a raw material for synthetic oil, it is well to note that practically every grade can be used. German experience with low grade coals indicates that the vast reserves of lignite and subbituminous coals in Wyoming, Colorado, Montana and North Dakota are potential sources of petroleum products. Generally, the utilization of coal for Fischer-Tropsch synthesis is expected to take place first in the bituminous regions east of the Mississippi River.

Even the anthracite industry is banking on the new technology. Primarily used for space heating, the mining and treatment of this coal has been less mechanized than the soft coal industry because the quality grades must be maintained. With about 25 percent of the original anthracite used up, the job of mining has become more difficult. Under-

Estimated Mineral-Fuel Reserves of the United States (U. S. Bureau of Mines)

Description	Reserve Jan. 1, 1946	Assumed annual production	Equivalent billions of net tons, bituminous coal, 13,000 B.t.u. per lb. calorific value[1] Reserve Jan. 1, 1946	Percent of total fuel reserve	Assumed annual production	Reserve divided by annual production plus loss[2]
Anthracite—billions of net tons	15	0.000	15	0.6	0.059	165
Low-volatile bituminous coal—billions of net tons[3]	52	.115	56	2.2	.124	317
High-volatile bituminous coal—billions of net tons[3]	1,351	.467	1,403	54.2	.485	2,024
Subbituminous coal—billions of net tons	818	.014	593	23.1	.010	.....
Lignite—billions of net tons	939	.004	484	18.7	.002	.....
Total, all ranks of coal, billions of net tons	3,175	.600	2,556	98.8	.680	2,505
Petroleum, billions of barrels[4]	20.8	1.7	4.8	.2	.392	12.3
Oil from oil shale	92	1.7	21.2	.8	.392[5]	54.1
Natural gas, trillions of cu. ft.[4]	135	4.0	5.2	.2	.154	34
Total, all fuels	.....	.....	2,587	....	1,226	1,057

[1] Heating values used in conversion: Anthracite, 12,700 B.t.u. per lb.; low-volatile bituminous coal, 14,000 B.t.u. per lb.; high volatile bituminous coal, 13,500 B.t.u. per lb.; subbituminous coal, 9,500 B.t.u. per lb.; lignite, 6,700 B.t.u. per lb.; crude petroleum, 6,000,000 B.t.u. per bbl.; natural gas, 1,000 B.t.u. per cu. ft. [2] 65 percent recovery is assumed for anthracite and 70 percent for all other coal and lignite. [3] Includes some medium-volatile coal. [4] Proved reserves only. [5] Not included in total.

Estimated Coal Reserves of the United States, 1936,* Billions of net tons

State	Anthracite	Bituminous	Subbituminous	Lignite	Equivalent bituminous
Alabama	....	66.6	...	...	69.0
Idaho and Oregon	....	0.7	1.8	...	2.0
Arkansas	0.2	1.3	...	...	1.5
Colorado	0.1	212.6	104.0	...	297.0
Georgia	....	0.9	...	...	1.0
Illinois	....	197.8	...	...	205.0
Indiana	....	52.0	...	...	54.0
Iowa	....	28.7	...	...	30.0
Kansas	....	29.7	...	...	31.0
Kentucky	....	121.5	...	...	126.0
Maryland	....	7.7	...	...	8.0
Michigan	....	1.9	...	...	2.0
Missouri	....	83.7	...	...	87.0
Montana	....	2.6	63.9	315.5	211.0
New Mexico	....	18.8	1.9	...	21.0
North Carolina	....	0.1	...	...	0.1
North Dakota	....	....	...	600.0	309.0
Ohio	....	92.0	...	...	96.0
Oklahoma	....	54.8	...	...	57.0
Pennsylvania	14.6	103.3	...	...	121.0
South Dakota	....	....	...	1.0	0.5
Tennessee	....	25.3	...	...	26.0
Texas	....	8.0	...	22.9	20.0
Utah	....	88.0	5.2	...	95.0
Virginia	0.5	20.6	...	...	22.0
Washington	....	11.2	52.4	...	50.0
West Virginia	....	147.7	...	...	155.0
Wyoming	....	30.3	590.0	...	462.0
Total	15.4	1407.8	818.2	939.4	2559.1

* Statement of W. E. Wrather, Director, Geological Survey: Hearings on Synthetic Liquid Fuels before a Subcommittee of the Committee on Public Lands and Surveys, U. S. Senate, 78th Congress, 1st Session, 1943, page 98.

ground gasification when successfully developed should be helpful in utilizing veins that heretofore have been uneconomical to mine. By use of cheap oxygen, it is expected that a synthesis gas can be produced to make the Fischer-Tropsch process profitable. If this works out, further mechanization of the mines will be possible because it will no longer be necessary to produce premium size grades.

It is obvious from this review of the nation's fuel reserves that ample supplies of coal are available to supply all fuel requirements for many years. While the cost may well be greater than the present cost of petroleum and natural gas, future developments in the more efficient utilization of fuels should go far in offsetting the cost of conversion. The first step is the synthesis of gasoline from natural gas and the second step is conversion of coal to synthesis gas and then to gasoline. This is technologicly feasible now. It was economical in Germany during the war and by all indications the improved engineering and techniques applied to the same general processes will make these syntheses economically feasible here. Fuel reserves will then be almost completely interchangeable.

Although the unbalanced condition of this country's various fuel reserves seems to point up the need for interchangeability of solid to gaseous and liquid fuels, the immediate prospect of accomplishing this would be remote were it not that modern fuel technology is ready. Based on German developments and re-engineered to take advantage of modern American techniques, the possibility of economically liquefying solid and gaseous fuels is believed by many to be near at hand.

Bulk of the work on the Bergius process has been handled by the U. S. Bureau of Mines in a long range program. This is still progressing and a 200 bbl. per day demonstration plant is being engineered for construction at Louisiana, Mo. The oil industry, however, hasn't been much interested in direct hydrogenation because the costs of production were too far out of line to be commercially promising. Bureau of Mines men still consider it a good bet and have hopes of bringing production costs down to where the process can be worthwhile as a supplementary producer of liquid fuel.

Fischer-Tropsch

It is the Fischer-Tropsch process that interests the oil men. Having developed the fluidized catalyst technique for use in oil refining it is only natural that it should be applied to this catalytic synthesis. Add to that the fact of cheap oxygen for preparing the synthesis gas and the keys to a synthetic industry appear to have been found.

Although publicity on synthetic gasoline has not been lacking, relatively few specific details have been given regarding American practice. A brief description of the German process and the more important modifications should make clear why the process looks promising.

Basic Fischer-Tropsch reaction is

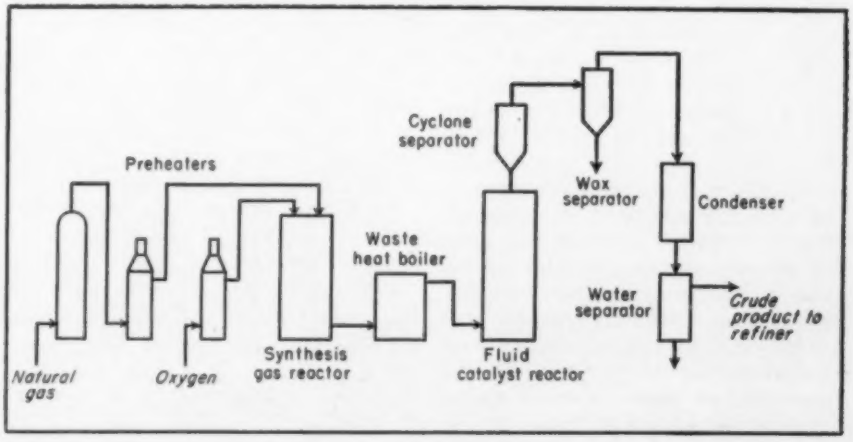
$$CO+2H_2 \rightarrow CH_2+H_2O.$$

The reaction was carried out in Germany over a mixed catalyst of cobalt-thoria-kieselguhr using a synthesis gas of carbon monoxide and hydrogen in a 1:2 ratio. Temperature of operation was from 355 to 385 deg. F. and the synthesis could be accomplished either at atmospheric pressure or at medium pressure of about 150 lb. per sq. in. Operating pressure for any given plant was determined to some extent by the products desired. Medium pressure synthesis is reported to produce a greater percentage of higher alcohols and gives a longer catalyst life than do operations at normal pressure. Atmospheric pressure operation favors a higher gasoline yield.

Heart of the plant is the synthesis chambers. These are small capacity and complicated and are designed to remove the heat from the exothermic reaction (about 7,000 B.t.u. per lb. of product). Each reactor used in the atmospheric process contains an assembly of metal fins about ¼ in. apart through which are installed cooling tubes. Catalyst is packed in the chamber and water is circulated through the tubes to remove the heat generated. Steam formed in the tubes is collected and is usually sufficient to supply the whole plant. Actual temperature range is quite narrow making necessary the complicated cooling system.

Water gas was commonly used for the synthesis after it was enriched with hydrogen to give the desired carbon monoxide hydrogen ratio. The synthesis gas was manufactured in standard, intermittent water gas sets involving no significant difference from well-known American practice. Part of the gas so obtained is subjected to the so called "shift conversion" whereby steam is introduced with the gas over a catalyst at about 900 deg. F. to form hydrogen and carbon dioxide. Carbon dioxide was

Schematic flow diagram of a Fischer Tropsch plant to make gasoline from natural gas



scrubbed out and the remaining hydrogen combined with the unconverted portion of the water gas resulting in a synthesis gas containing the desired ratio of hydrogen and carbon monoxide.

Synthesis gas is then passed through a two-stage treatment for removal of sulphur which poisons the catalyst. The tolerance is about 0.1-0.2 grains per 100 cu. ft. of gas. In the first stage hydrogen sulphide is removed by contacting the gas with iron oxide. Organic sulphur such as carbon bisulphide and mercaptans were contacted with a catalyst, comprised mainly of ferric oxide and soda ash at temperatures of from 350 to 540 deg. F.

The gas is then passed to the reaction chamber where hydrocarbon synthesis takes place. The products and unconverted gas are separated in a condenser and cooled. Unconverted gas containing light ends passes to an activated carbon absorber or to a condenser where the oil vapors and hydrocarbon are recovered. The crude product is separated from the water and is then refined by conventional methods.

Capacity

Daily capacity of a single synthesis unit averaged about 15 bbl. so each plant was necessarily made up of a large number of small units. A 1,500 bbl. per day plant would thus require 100 reactors and a variety of auxiliary equipment. One of the main disadvantages of this type of plant was the fact that the reactors were too expensive, too complex and too large per unit output.

Perhaps the greatest improvement made on this process in this country was to adapt the fluidized catalyst technique to the synthesis reaction. Essentially this consists in introducing the gas feed into the bottom of a reaction chamber filled with fine catalyst suspended or fluidized into the vapor stream. Reaction takes place in the turbulent mixture of catalyst powder, products and reacting gases. Catalyst particles carried with the reaction products are removed by means of a cyclone separator at the top of the reactor.

While use of fluid catalyst increases the accessible surface to allow greater speed of reaction and much greater throughput, one of its main advantages is that it permits better temperature control. Heat of reaction may be removed by circulating the fluid catalyst outside the reactor or by the production of steam in water cooled tubes extending vertically into the reaction zone. The constant and violent motion of the catalyst aids in holding a uniform temperature within fairly close limits. Based on pilot plant data, yields from the fluidized catalyst reactor under medium pressure using an iron base catalyst instead of the cobalt catalyst have resulted in conversion efficiencies more than double those achieved in Germany. Space velocities in volumes of fresh feed per volume of catalyst are increased from 100-250 for the German operation to 2000-3000 for fluidized iron catalyst.

Conversion of natural gas (methane) to synthesis gas may be accomplished in several ways. The method to be used in both of the plants now projected is a controlled oxidation as follows:

$$2CH_4 + O_2 \rightarrow 2CO + 4H_2$$

Preheated natural gas and oxygen are reacted at either atmospheric pressure or at 150 to 250 lb. per sq. in. and at a temperature of about 2,100 deg. F. The reaction is exothermic, and once the gas and oxygen are brought together and preheated, the reaction supplies the heat of the process. This takes place in large diameter reactors where a nickel catalyst may be used to promote the reaction. Availability of cheap oxygen is the key to a low cost synthesis gas from natural gas.

Practical methods of converting coal to synthesis gas, now under development, are based on both cheap oxygen and on fluidization. Undoubtedly this work has been promoted by a study of some of the German methods. Two of the most promising are the Lurgi process and the Winkler process although there are others that may prove equally important.

While most of the German Fischer-Tropsch plants used hydrogen enriched water gas as a raw material, a number of lesser known processes for gasifying coal were developed. Not only was synthesis gas produced but industrial and household gas was made by these newer methods.

The Lurgi process is a continuous gasification process using steam and oxygen under pressure from 10 to 30 atm. It was designed for processing low grade non-caking coals. Capable of gasifying coal in sizes from 1 in. to 3/32 in., the process is characterized by high yields of gas whose composition may be varied with wide limits by changing the pressure, the amount of steam and oxygen introduced and the rate at which the fuel is changed.

Coal is fed into the top of an insulated vessel maintained under pressure. Into the bottom of the reactor is fed a mixture of steam and oxygen. By incomplete combustion the coal is gasified, some oil is recovered and the ash is removed intermittently from the bottom. The resulting gas having calorific values up to 570 B.t.u. per cu. ft. is discharged at the reactor pressure and can be readily piped considerable distance without pumping costs.

While the Lurgi process is designed chiefly for the production of high heating value gas, the Winkler generator is used for manufacturing gas which may be used for synthesis of ammonia, gasoline, etc. Characteristic features of this process are that it is a continuous and complete coal gasification process made possible by use of oxygen for internal heating. Gasification of powdered fuels, low grade slack coals or friable coals can be accomplished at high rates and high capacities.

Winkler Process

The principle of the process is similar to that of the fixed bed fluid catalyst in that powdered coal or coke is agitated by the steam and oxygen which is blown in under the bed. Essentially, the Winkler generator consists of a vertical cylinder with a grate at the bottom through which the steam and oxygen enter. The pulverized fuel suspended in the upward flowing stream rapidly undergoes gasification. Depending on the proportion of oxygen, the gas produced resembles the composition of producer gas, blue gas, or a combination of both. Loose slag sinks to the grate where it is cooled by the entering air. Most of the ash is carried upward with the gas and is removed in a cyclone. Each Winkler unit is equipped with a waste heat boiler, superheater, feedwater heater cyclone, scrubber, etc.

These and other processes are under investigation by the gas industry, and there is little doubt that continuous, complete gasification of coal will be made possible by such developments. Improvements, comparable to those made in the Fischer-Tropsch process, may well lead to a high B.t.u. gas which can be economically transported similar to present natural gas transmission.

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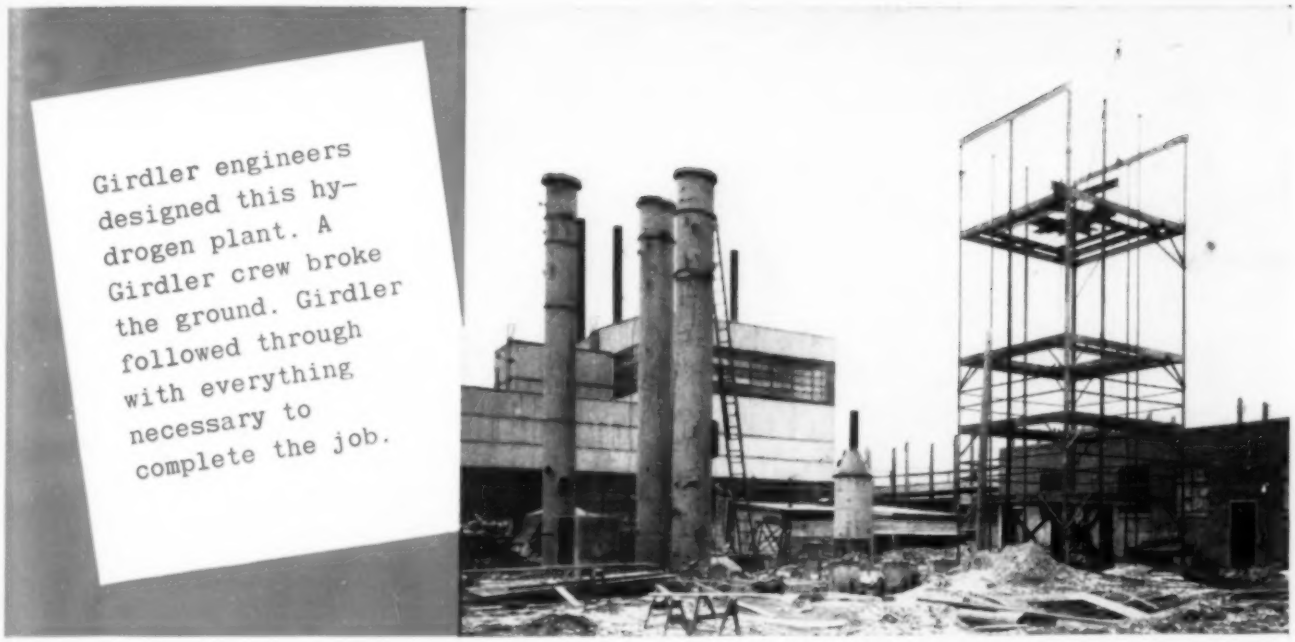
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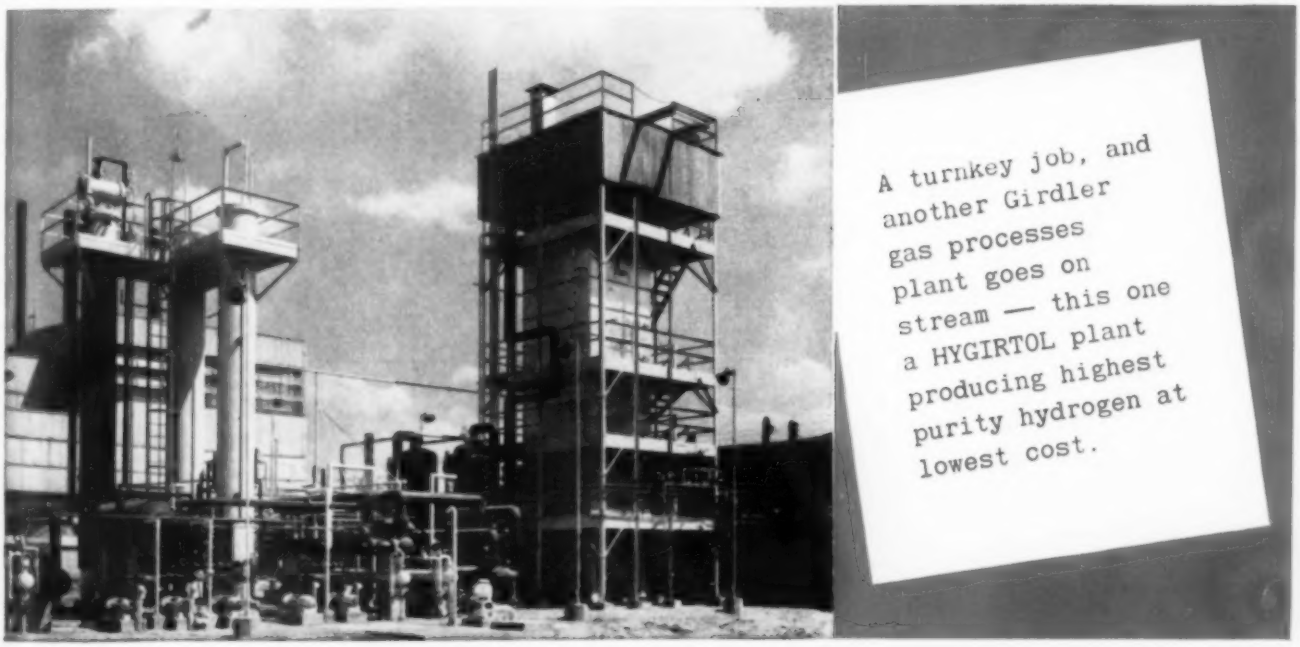
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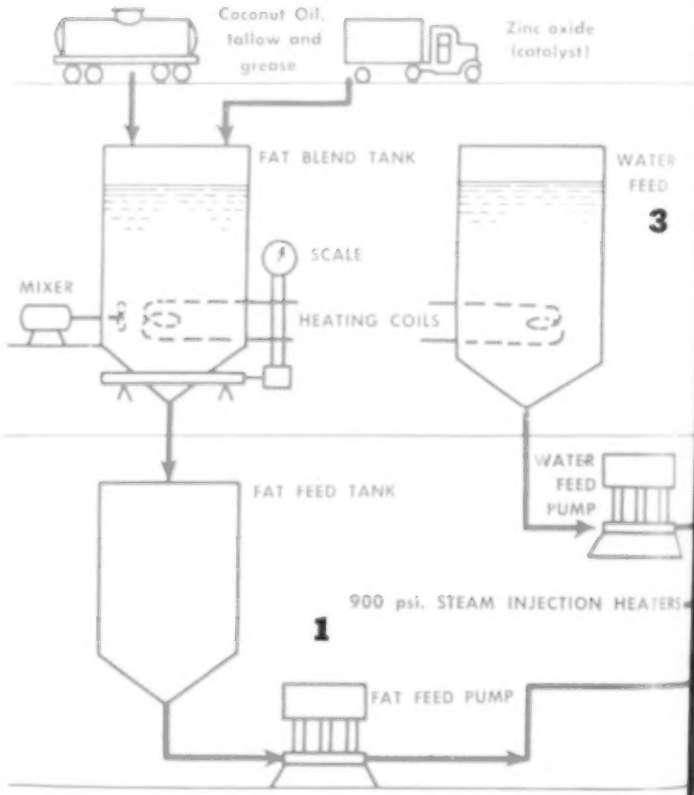
1 Stock is pumped from feed tank to hydrolyzer by high-pressure triplex piston pump

3 Near hydrolyzer is this central panel board where temperatures, pressures, and pump speeds are controlled



CONTINUOUS SOAPMAKING

CHEMICAL engineering has modified conventional soap boiling operations so that only the raw materials and finished products look familiar. Soap is now being made, from raw fats to finished products, in a matter of hours instead of the many days formerly required.

This process as developed by the Procter & Gamble Co. is continuous countercurrent hydrolysis under pressure and at high temperature with a catalyst, followed by continuous distillation, neutralization, and finishing. The mixture of fats, in the proper proportions for whatever soap is being made, reacts with water under pressure in a vertical column to split into fatty acids and glycerine.

Crude fatty acids coming from the hydrolyzer are purified by dry vacuum distillation, and the distillate is neutralized to yield "neat soap." The neat soap is comparable to that produced in the kettle and may be handled in a variety of ways depending upon the desired soap product. It may be extruded, framed, milled, flaked, or spray-dried.

Byproduct glycerine recovered from the hydrolyzer gives a better product than that recovered from the soap kettle. It is concentrated in a multiple effect evaporator which is synchronized with fatty acid production.

This continuous process has placed soapmaking in the ranks of modern chemical engineering. Greater flexibility, more accurate control, improved color of soap, improved glycerine recovery, smaller space requirements, and other advantages make this process highly valuable. Once again, an art has been modernized by the application of science and good technology.

The accompanying flowsheet shows this modernized technique as adapted to floating-soap production. For this, final moisture reduction is accomplished by heating the neat soap and flashing off some of the water. Cooling the soap is accomplished in a Votator and conventional cutting, stamping, and wrapping operations finish the process.

For a more detailed description of the process see pp. 94-97 of this issue of *Chemical Engineering*.

CHEMICAL ENGINEERING
April, 1947
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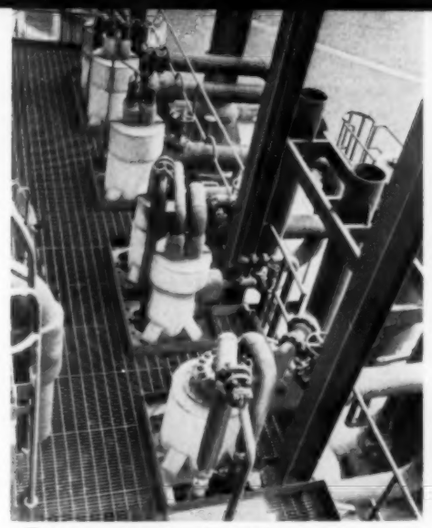


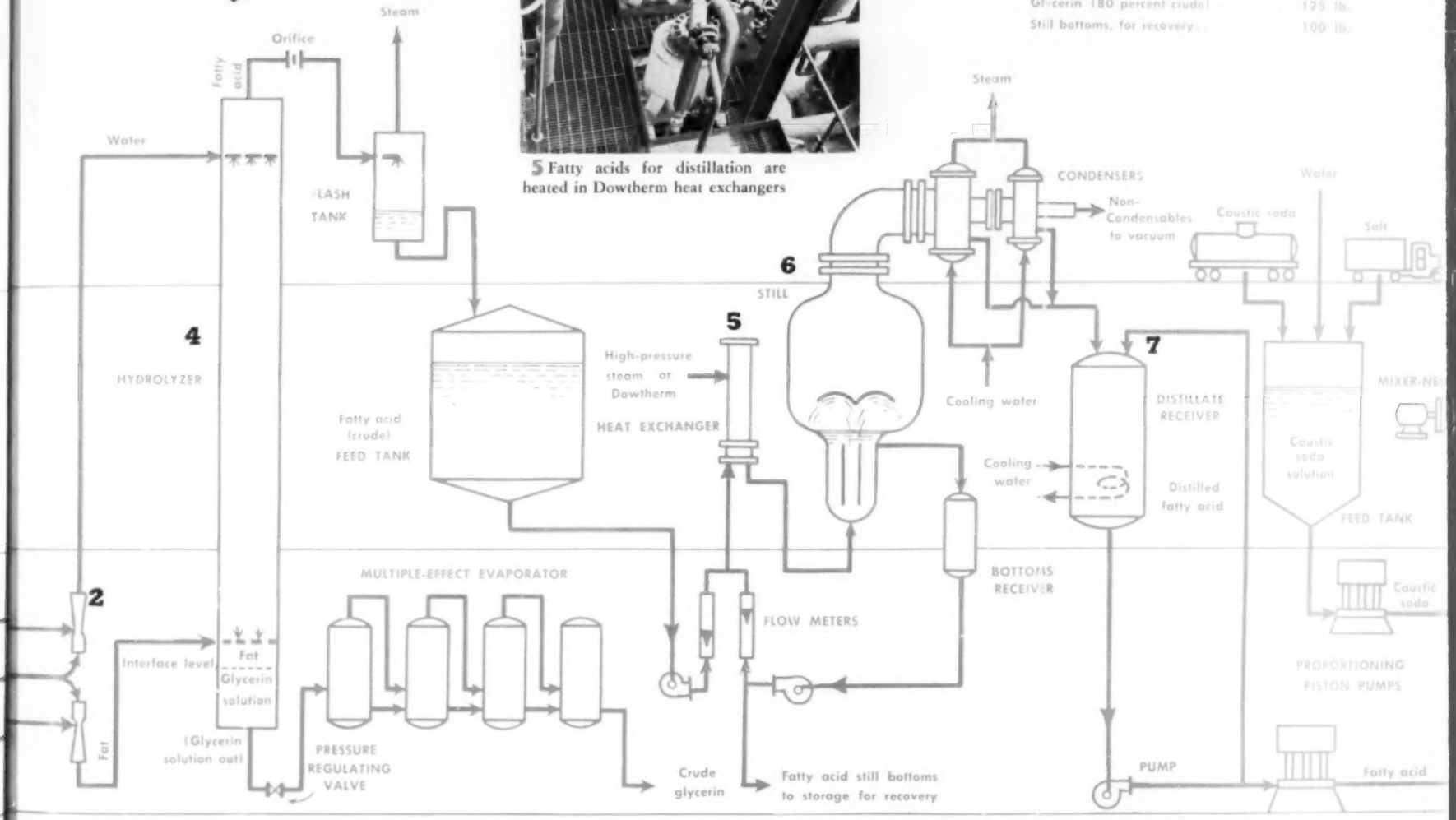
5 Fatty acids for distillation are heated in Dowtherm heat exchangers

MATERIALS CONSUMED

Fat	[illegible] lb.
NaOH	[illegible] lb.
Salt	[illegible] lb.

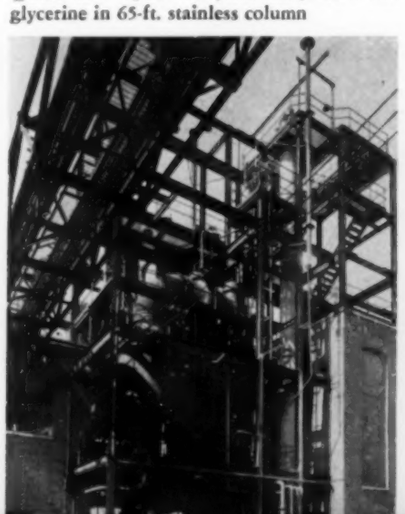
PRIMARY PRODUCTS

Soap (30 percent moisture)	1,350 lb.
Glycerin (80 percent crude)	125 lb.
Still bottoms, for recovery	100 lb.

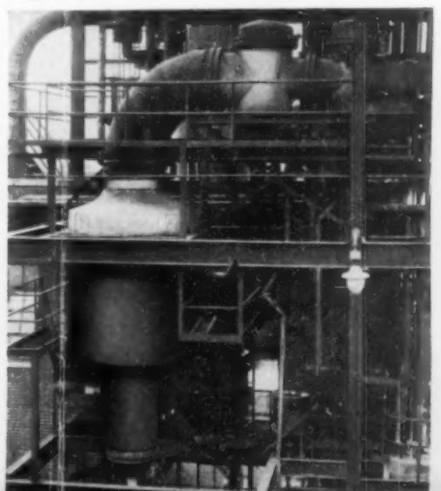


2 Fat mixture, water and all other materials flow for the hydrolyzer is controlled at this centrally located valve bank

4 Fats are "split" to yield fatty acid and glycerine in 65-ft. stainless column



6 Fatty acids are continuously distilled under high vacuum in stainless steel vessel



8 Fatty
of caustic

RIALS CONSUMED

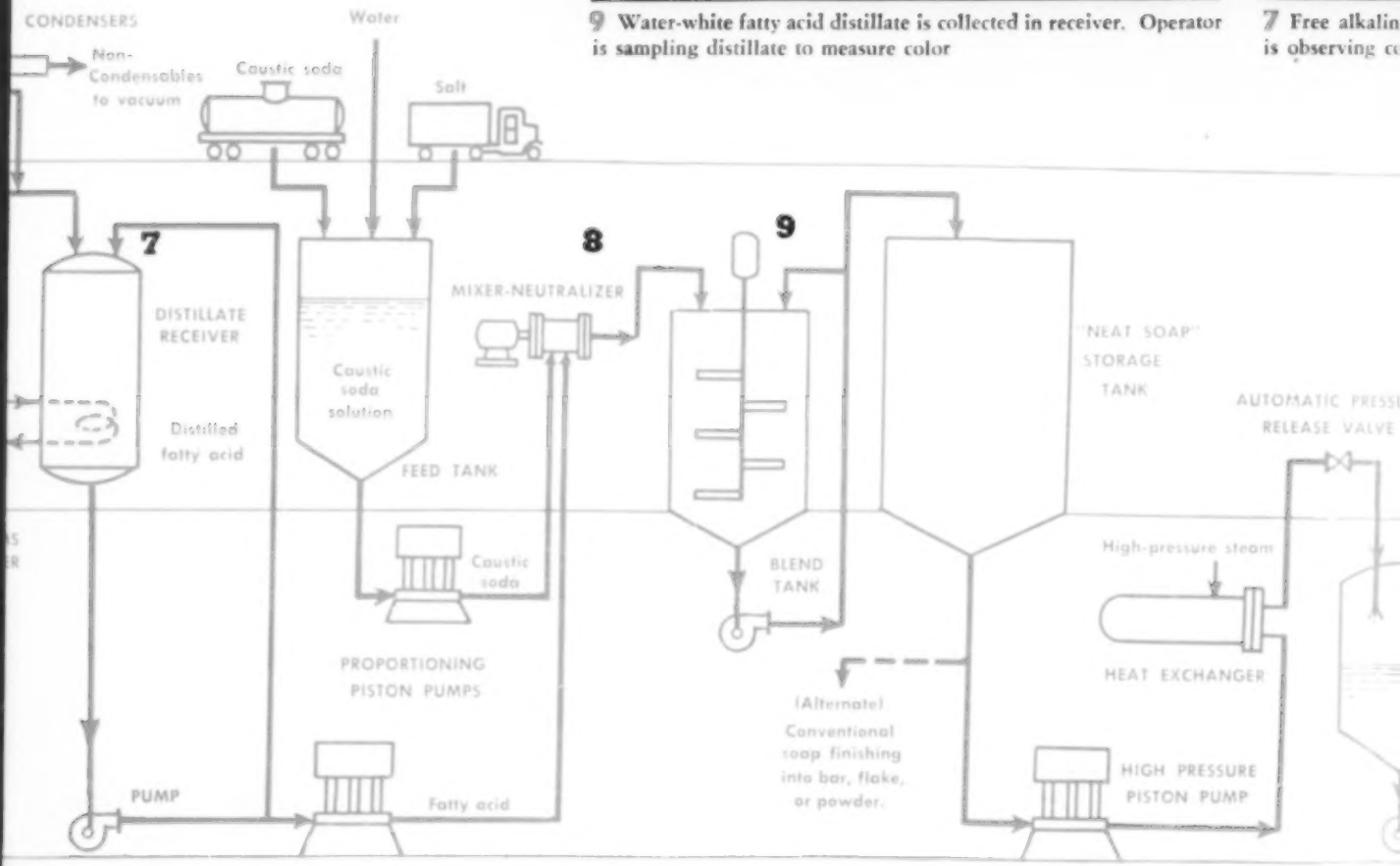
	1,000 lb.
OH	135 lb.
	5 lb.

ARY PRODUCTS

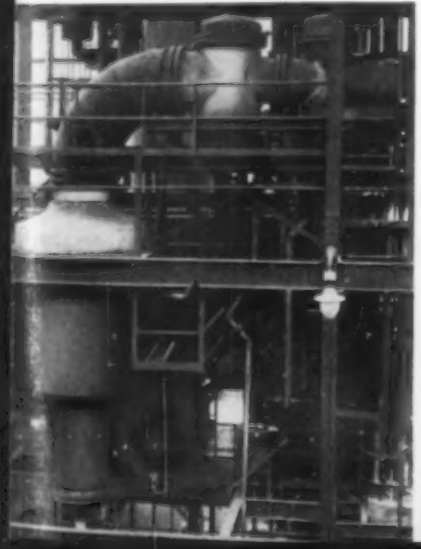
p (30 percent moisture)	1,350 lb.
cerin (80 percent crude)	125 lb.
l bottoms, for recovery	100 lb.

9 Water-white fatty acid distillate is collected in receiver. Operator is sampling distillate to measure color

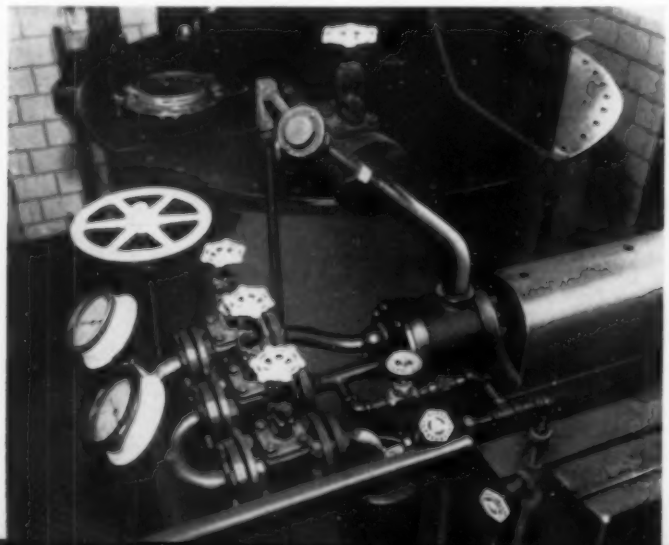
7 Free alkalin
is observing co



y acids are continuously distilled under acuum in stainless steel vessel



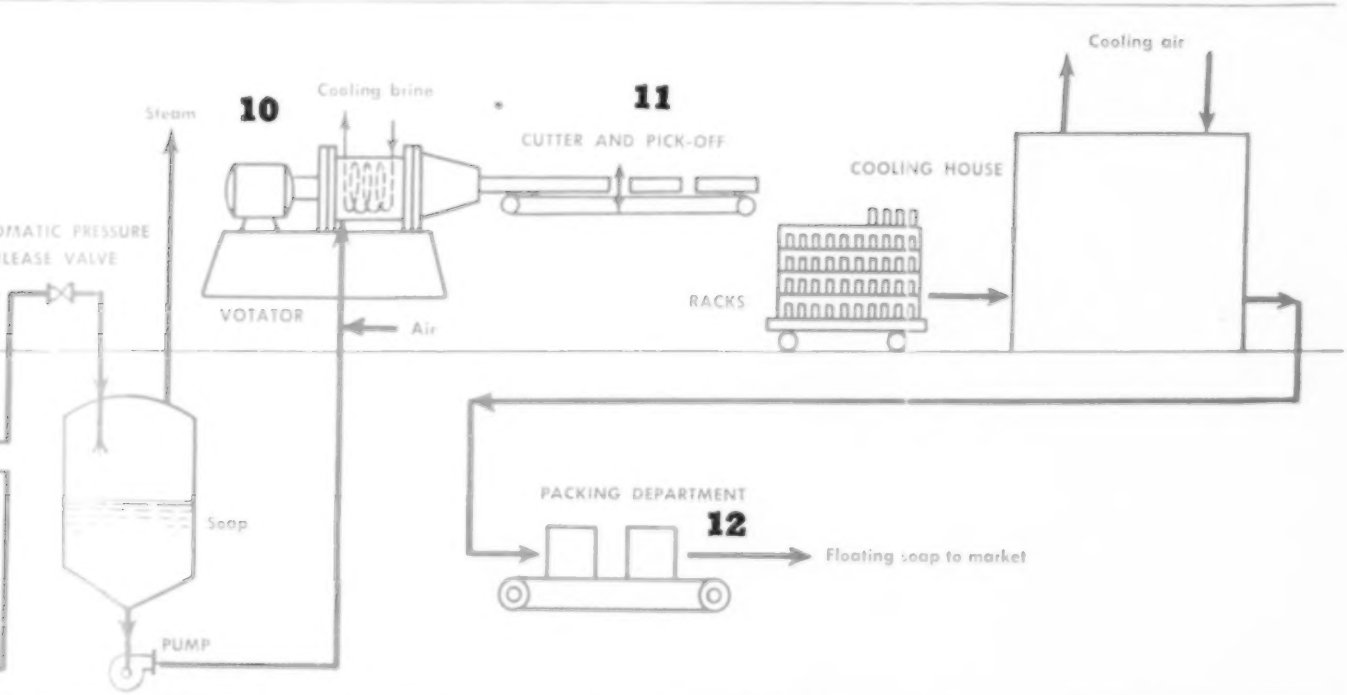
8 Fatty acid is neutralized by mixing with a proportional quantity of caustic soda solution in a high-speed mixer



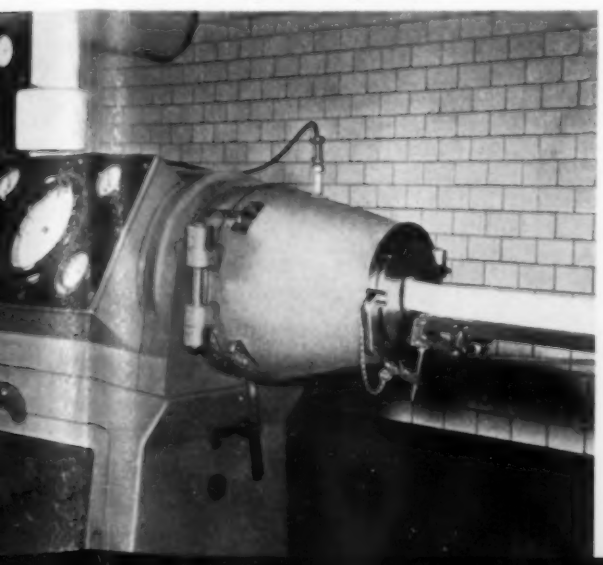
10 Soap goes from flash ta
cooled until it can be extru

Free alkalinity of soap is adjusted by sampling in blend tank. Operator observing color change caused by drops of indicator

11 Rapidly moving plastic strip is cut into three-bar lengths and placed on trays for further cooling



from flash tank to Votator where it is mixed with air and t can be extruded as a shape-retaining strip



12 The lettering and distinctive style of the final bars are impressed by conventional soap stamping equipment

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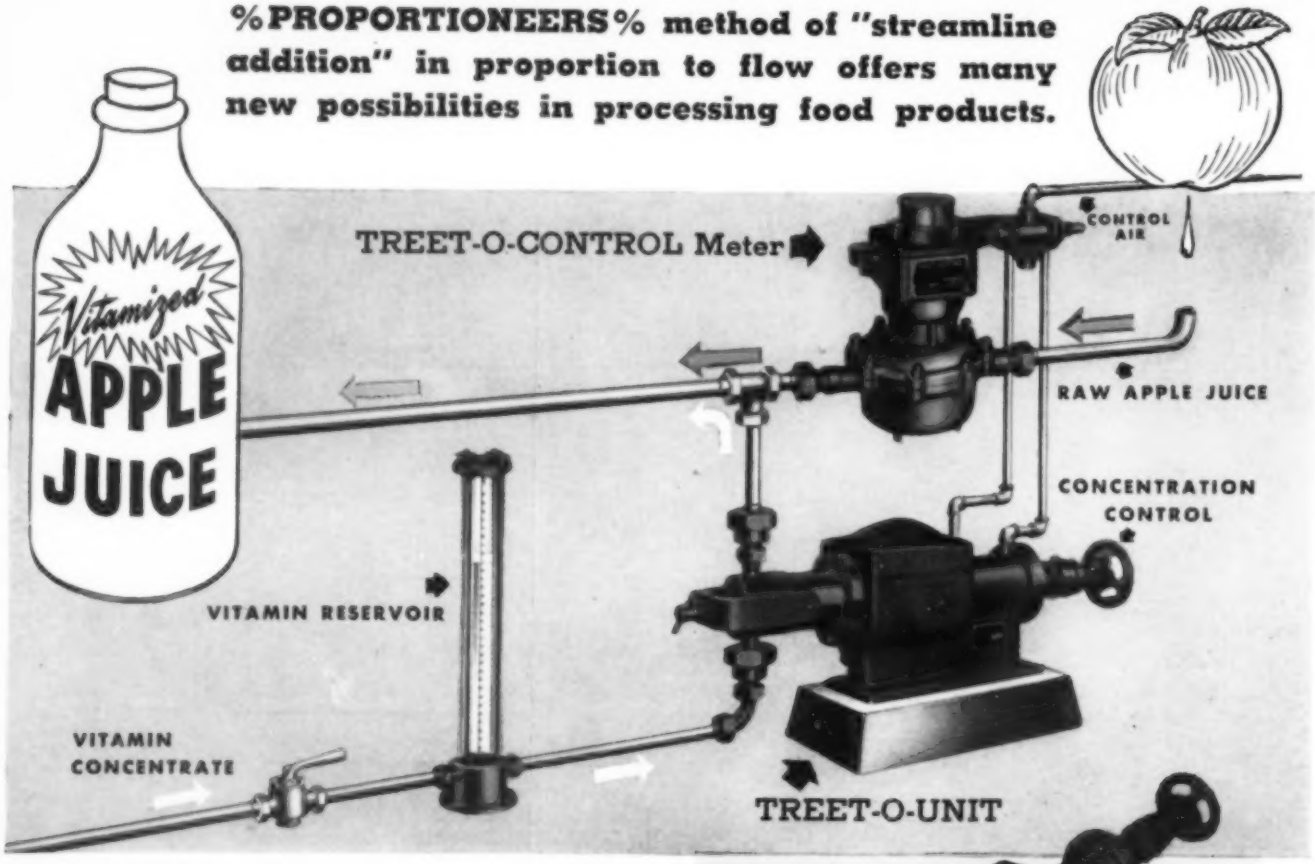

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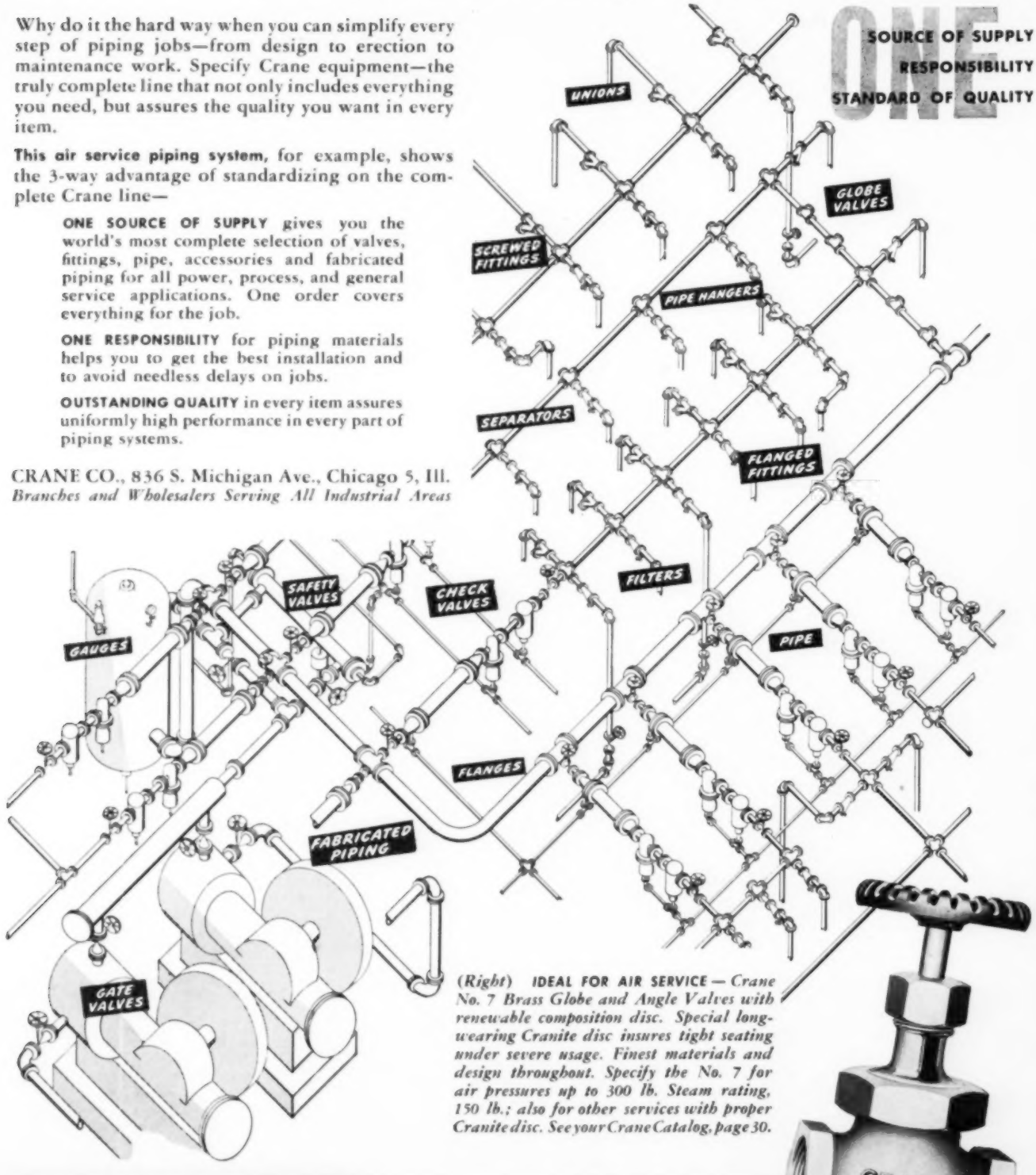

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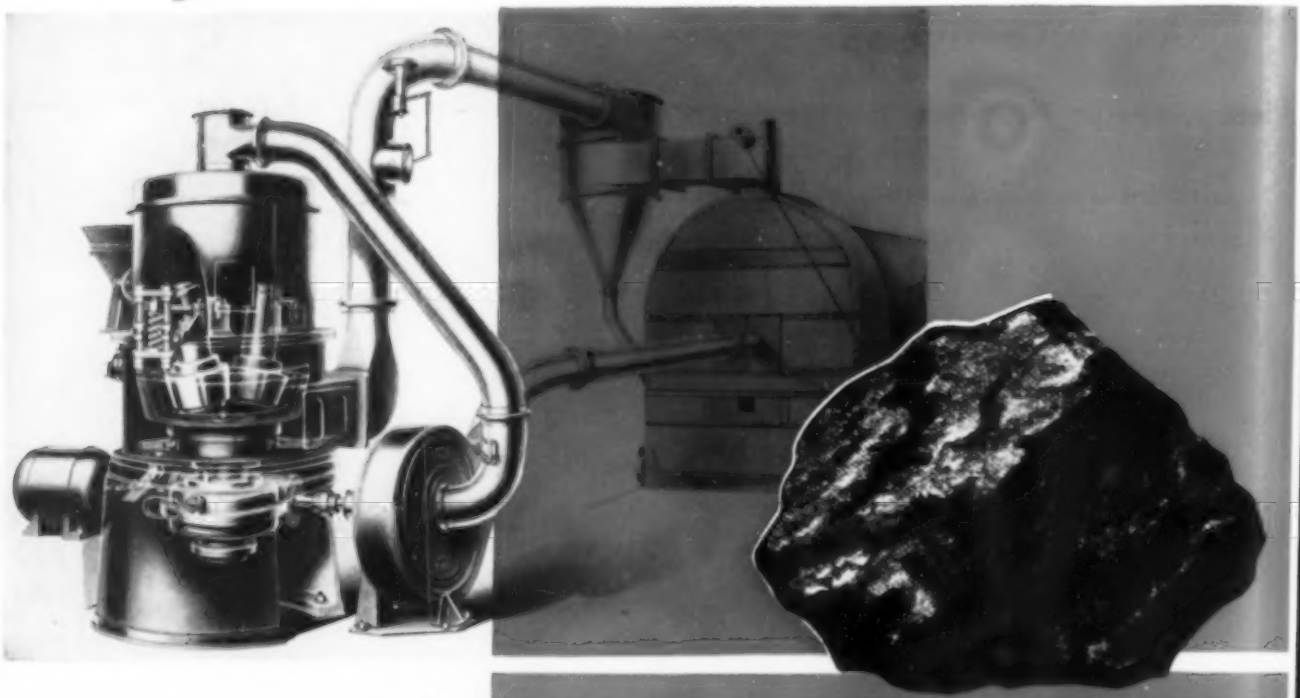

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PROCESS EQUIPMENT NEWS

Theodore R. Olive, ASSOCIATE EDITOR

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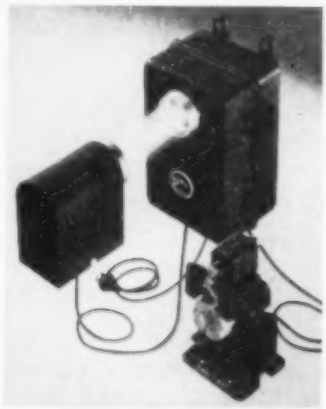
1. Photoelectric Counter

UNDER the designation of Type P1, Photoswitch, Inc., 77 Broadway, Cambridge 42, Mass., has introduced a new photoelectric counter which in a completely packaged, easily installed, general-purpose instrument provides for the high speed counting of packages, small objects, bottles, etc., or for selective counting by height or length. The equipment consists of a photoelectric control, a light source and an electric counter. Since the necessary cables and plugs are provided for connecting the unit and plugging it into any standard lighting outlet, the equipment can quickly be installed without the help of an electrician. The device will make up to 600 counts per minute.



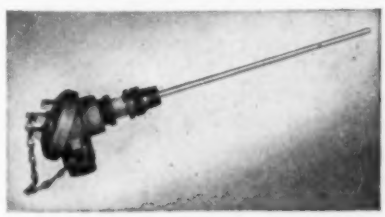
Photoelectric cell, light source and counter

2. Oxygen-Arc Cutting

COMBINATION of an electric arc and a stream of oxygen is used in the new Oxyarc process for cutting stainless, alloy steels, and other alloys, developed by the Arcos Corp., Gulf Bldg., 1515 Locust St., Philadelphia 2, Pa. The equipment consists of a specially designed holder and a special tubular coated rod, the latter being consumed in the process of cutting. This process can be used wherever an a.c. or d.c. welder and bottled oxygen are available. It is claimed that the knack of cutting by this process can be mastered in less than one hour's time. This system makes use of a highly concentrated pinpoint of heat generated by the combination of electric arc and a stream of oxygen. The arc is established between the covered tubular rod and the metal to be cut, while the oxygen is supplied through the tube.

3. Resistance Thermometer

A NEW TYPE of fast-acting resistance thermometer bulb known as the Thermohm, which extends the range of resistance thermometer recorders and controllers to temperatures as high as 1,000 deg. F., has been announced by Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa. This instrument is said to be amply accurate for the more exacting industrial requirements, yet much faster than the usual heavy-gage thermocouples. Its speed is said to be matched only by small pipe-type on fine-wire couples. The bulb is incased in a corrosion resisting stainless tube which gives it protection against normal pressures and non-corrosive fluids. Otherwise, it can be used with a protecting well. The temperature coil itself is said to be thoroughly protected against contamination by moisture or gases. Like this company's thermocouples and lower-temperature resistance thermometers, the new Thermohm is equipped with a standard universal head to facilitate installation and connection.



Fast-acting resistance thermometer bulb

FOR MORE INFORMATION
See Reader Service
Coupon on pages 157-158

4. Diaphragm Control Valve

UNDER the designation of Series 700, H. Belfield Co., Broad St. at Hamilton, Philadelphia 23, Pa., has introduced a new line of air-operated diaphragm control valves featuring decreased friction and increased sensitivity. The new series is built in a variety of types to cover all requirements including variations in flow characteristics, for which eight different types of valve plugs and pistons are available. The valve may be provided with radiation fins, with a positioner, manual operating means, in packless construction, and for three-way control, as well as in other modifications. Standard construction employs a reinforced, molded neoprene diaphragm, special stuffing box con-

struction and lubrication, and special means of inner valve guiding.

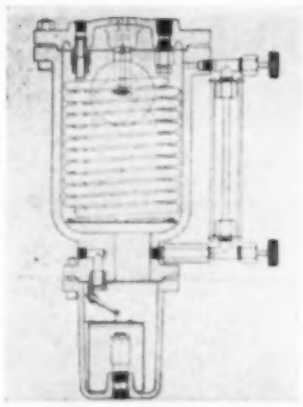
5. Palletless Handling

A NEW METHOD of simplified materials handling, in which unit loads are mounted on disposable carrier sheets of corrugated paper board or other material, instead of on conventional wood or metal pallets, has been announced under the name of Pul-Pak by Clark Tructractor Division, Clark Equipment Co., Battle Creek, Mich. As shown in the illustration, the method employs a fork lift truck equipped with a flat steel plate in place of the conventional forks, combined with a push-pull attachment. In the illustration the push-pull device is shown in the retracted position. The unit load, supported on an inexpensive load base of paper or other material, is approached by the truck with the carrier plate held as shown. A gripper which is part of the push-pull attachment then advances and grips the edge of the paper load base and pulls the load on to the carrier plate. At the destination the load is lifted and registered directly over the area on which it is to be deposited, and the pusher device, working against the load, deposits the carrier sheet and its cargo in the desired position as the truck backs away and withdraws the carrier plate.

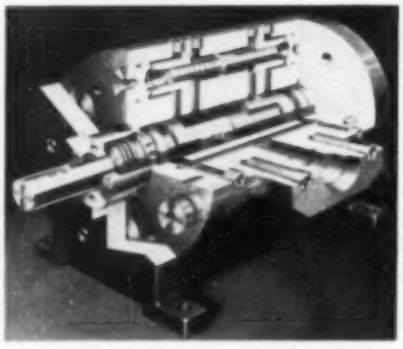
This new system is said to reduce pallet costs greatly, to require no pallet maintenance and to save practically all the storage space required for empty pallets. There is of course no cost for returning pallets, while freight cost is reduced by pallet weight elimination. The system permits both packages and bags to be handled as on ordinary pallets and enables tiering of loads to be more compact and more secure, according to the manufacturer.

6. Refrigerant Purger

NON-CONDENSABLE gases can be purged from refrigeration systems with an efficiency said to range from 98 to 100 percent by means of an improved refrigerating system purger announced by Armstrong Machine Works, 858 Maple St., Three Rivers, Mich. The design is essentially the same as that of older models produced by this company except that the refrigerating jacket formerly used has been replaced by an internal coil which increases the condensing surface by approximately 50 percent. In addition, the new purger incorporates a new non-condensable gas discharge mechanism in which the ball float used to actuate the valve has been enlarged and the valve itself improved. The purger is made in two styles, No. 270 with a semi-steel body for pressures up to 200 psi. and No. 370 with a forged steel body for pressures to 300 psi. The device is said to be suitable for practically all refrigerants used in compression-type systems. In addition to refrigeration applications, it is claimed to be suitable for gas purification processes in petroleum and chemical industries.



Cross section of refrigerant gas purger



Cutaway view of pressure booster

As shown in the accompanying illustration, the purger consists of a double body, the upper containing an evaporating coil, and the lower an inverted bucket trap. Non-condensable gas introduced under the bucket bubbles up through a small orifice in the bucket top and contacts the cold coil. Portions which will not condense collect in the top and are released by a simple float-controlled needle valve. Excess liquid formed by the condensed portion is discharged through the valve controlled by the bucket into the evaporation coil where it helps to supply the chilling effect needed to operate the purger.

FOR MORE INFORMATION

See Reader Service Coupon on pages 157-158

Pul-Pak palletless handling method in use

Lightweight hand pallet truck

7. Hydraulic Booster

HYDRAULIC pressures as high as 7,500 psi. can be supplied by means of a new oil-hydraulic pressure booster announced by Hydro-Power, Inc., Springfield, Ohio. Providing working pressures substantially higher than those normally obtained with high-pressure pumps, the booster is said to open new possibilities in the field of high-pressure hydraulics. The device is a compact, multi-plunger intensifier which will multiply by as much as three times the pressure of the oil it handles in a hydraulic circuit.

The power unit comprises a cylinder block having a nest of six parallel bores, each fitted with a reciprocating, double-acting piston. A central rotating valve member connects the pistons with the source of pressure fluid. As the valve rotates, the oil connections are made successively to the pistons, alternating from one end to the other to provide an uninterrupted pressure flow. The new booster is said to operate without any appreciable increase in system horsepower, the only additional power requirement being for the rotation of the central valve which itself is in complete hydraulic balance, eliminating high bearing loads.

These boosters are built in two

Safe... STORAGE TANKS *Inexpensive* FOR SMALL QUANTITIES OF *Fine Chemicals*

"Junior Series" containers (without legs) are made in 5, 10, 20, 30, and 50 gallon sizes. Tanks from 30 to 100 gallons are self-draining, equipped with a stainless steel flush valve as standard. (Other valves available.) Any unit may be obtained with side or bottom agitator, one-piece stainless steel cover, open or closed gauge glasses or castors on legs. Ask for Bulletin 815.

GLASS LINED STEEL...

...the answer to many small storage and mixing problems which require resistance to acids . . . is available in standard Pfaudler "Junior Series" storage and mixing tanks, ranging in capacities from 5 to 100 gallons. Lined with Pfaudler acid resisting blue glass on the inside and with gray-white porcelain enamel outside, this equipment affords safe, clean storage for such products as pharmaceuticals, biologicals, acid or non-acid solvents, etc. Bushings, valves, agitators, and gauge glass fittings are made of (18-8) stainless steel, a limiting factor with respect to corrosion resistance.

STAINLESS STEEL...

..."Precision-built" in every sense...is available in small standard Pfaudler storage and mixing tanks, 30 to 500 gallons in size. All are fabricated of 18-8, Type 302 stainless steel with No. 4 polish inside and out. (Other finishes are available.) All seams are welded with stainless steel welding rod—no solder—and all welds are ground and polished. Bottom heads are channeled to outlet nipple near side wall for complete drainage. Sanitary in every detail, they are easy to clean and economical to maintain.

Pfaudler "Precision-built" stainless steel flat bottom containers are built on special order from 30 to 100 gallons only. Standard units, 30 to 500 gallons, include vertical open, vertical closed and horizontal types. One piece stainless steel covers are available for open tanks. Any unit may be obtained with stainless steel flush valve, side or bottom agitator, open or closed gauge glasses, castors for legs. Ask for Bulletin 822.

Pfaudler

THE PFAUDLER CO., Rochester 4, New York. Branch Offices: 330 West 42nd St., New York 18, N. Y.; 111 W. Washington St., Chicago 2, Ill.; 1325 Howard St., San Francisco 3, Calif.; 818 Olive St., St. Louis 1, Mo.; 7310 Woodward Ave., Detroit 2, Mich.; 1318 1st Nat'l. Bank Bldg., Cincinnati 2, O.; 1041 Commercial Trs. Bldg., Philadelphia 2, Pa.; 751 Little Building, Boston 16, Mass.; Box 982, Chattanooga 1, Tenn.; Enamelled Metal Products Corp., Ltd., Artillery House, Artillery Row, London, S. W. 1, England.

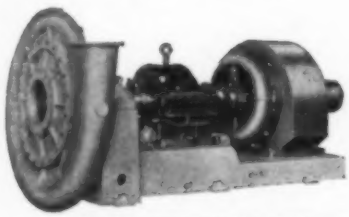
THE PFAUDLER CO., ROCHESTER 4, NEW YORK

ENGINEERS AND FABRICATORS OF CORROSION RESISTANT PROCESS EQUIPMENT

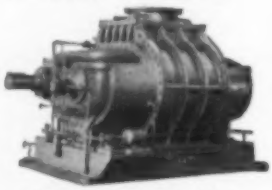
Glass-Lined Steel . . . Stainless Steels . . . Nickel . . . Inconel . . . Monel Metal

PLUS-VALUE ASSURED

Special design Rotary unit for scavenging Diesel engine

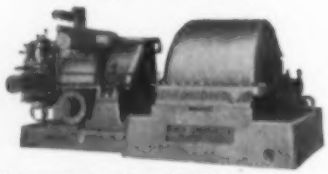


Single-stage Centrifugal Blower



Rotary Positive Gas Pump

Positive Displacement Meter



Multi-stage Centrifugal Blower

Small Rotary Positive Blower for separate or built-in mounting

WITH

R-C equipment

You get a plus-value when you bring your air or gas handling equipment problems to Roots-Connersville. That's because of our *dual-ability* to engineer and build either the Centrifugal or Rotary Positive types of Blowers, Exhausters and Boosters. Completely independent thinking permits us to supply exactly the right unit for your needs.

Roots-Connersville also builds Positive Displacement Meters, Liquid and Vacuum Pumps and Inert Gas Generators, in a wide variety of sizes and types. Our long experience assures completely satisfactory performance, resulting from advanced engineering plus precision workmanship.

For intelligent answers to your equipment problems, you can depend upon Roots-Connersville know-how.

ROOTS-CONNERSVILLE BLOWER CORPORATION
704 Illinois Avenue, Connersville, Indiana

ROOTS-CONNERSVILLE
ROTARY CENTRIFUGAL
BLOWER BUILDERS R-C SINCE 1854
BLOWERS · EXHAUSTERS · BOOSTERS · LIQUID AND VACUUM PUMPS · METERS · INERT GAS GENERATORS

• • ONE OF THE DRESSER INDUSTRIES • •

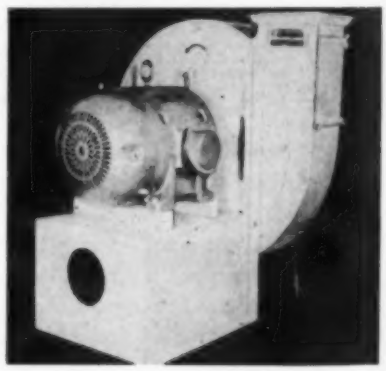
standard sizes, 35 and 100 g.p.m. input, with the volumetric output varying in inverse proportion to the pressure ratio. Each size is built in two distinct pressure ranges, 2¼ to 1 and 3 to 1. All units have a maximum discharge pressure of 7,500 psi.

8. Lightweight Pallet Truck

FOR PALLET loads up to 2,000 lb., the Lyon-Raymond Corp., 3185 Madison St., Greene, N. Y., has developed a hand pallet truck of streamlined design with all working parts inclosed. So light is the truck that two men can raise it from ground level to the bed level of a highway truck. Load elevation is accomplished by means of a hydraulic foot pump, with lowering controlled by pushing the foot lever forward.

9. Industrial Fans

BELT and motor-driven steel-plate fans for industrial applications are now being designed and manufactured by Sprout-Waldron & Co., Muncy, Pa. Fan blades of the deep radial type are said to develop high static pressure while the open impeller design permits solid material to bypass the blades, reducing wear. For applications where the handling of abrasive material requires frequent replacement of ordinary fan housings, the new fan can be provided with a tough, abrasion-



Steel-plate industrial fan

resistant liner insert. These fans are available in sizes for pipe diameters from 6 to 14 in. for a wide range of capacities, depending on the static pressure.

10. Packless Control Valve

SIMPLIFICATION of the control of many difficult and dangerous processes is claimed for the bellows-sealed construction employed in the 3000B series of packless diaphragm control valves announced by Hammel-Dahl Co., 243 Richmond St., Providence 3, R. I. These valves have been subjected

VICTOR Chemicals

for... BAKING

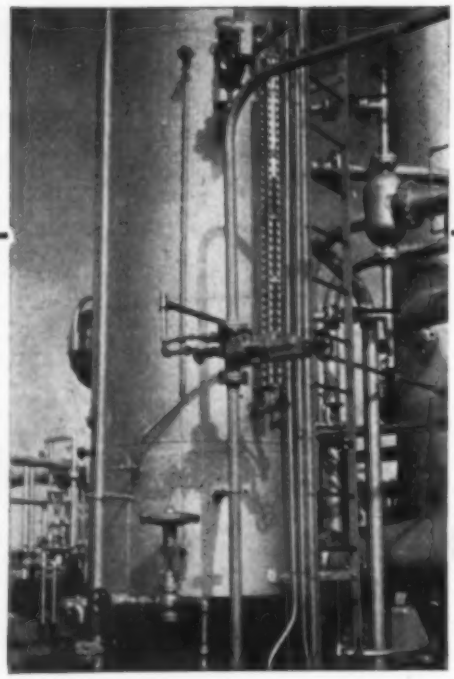
VICTOR CHEMICAL WORKS

Victor Calcium Phosphate, because of its controlled leavening action, is widely favored in the manufacture of cookies and other baked goods. Its popularity depends upon the fact that cookie dough so leavened will not expand until oven heat is applied. Hence, when a large batch of dough is run through a volume depositor, uniform size and weight of the cookies are assured throughout the complete run. ¶ Victor Chemicals used in the baking industry include: **Diammonium Phosphate** (control the pH of soda crackers), **Monoammonium Phosphate** (yeast, yeast foods and bread improvers), **Calcium Phosphates** (phosphate baking powders, angel food cakes, self-rising flour, cookies, pancake flour, prepared cake mixes, bread improvers, and as a rope preventive in bread), **Phosphoric Acid** (yeast), **Sodium Acid Pyrophosphate** (baking acid in prepared doughnut flours, cake mixes, commercial baking powders, and baking creams).

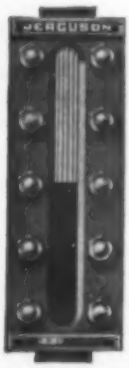
VICTOR CHEMICAL WORKS, 141 W. Jackson Blvd., Chicago 4, Ill.

NEW YORK • KANSAS CITY • ST. LOUIS • NASHVILLE • GREENSBORO, N. C.

Plants: NASHVILLE • MT. PLEASANT, TENN. • CHICAGO HEIGHTS, ILL. • VICTOR, FLA.



You Can See Liquid Levels . . . Quicker and Easier with JERGUSON REFLEX GAGES



Single Section Jerguson Reflex Gage

YOU can see liquid levels quicker and easier with Jerguson Reflex Gages because the level shows as a sharp, clear line. The liquid shows black, contrasted with a brilliant mirror-like appearance above.

This quicker, accurate reading of liquid levels gives you better control . . . real insurance against accidents or shut-downs occuring from failures to observe correct readings.

Jerguson Gages and Valves are made of any desired metal, or with lined construction, to withstand corrosive action. Precision built . . . with a lot of advantages that you will find important in your operation. They have a third-of-a century good reputation for accuracy and value.

Write for engineering data units on gages and valves to meet your specific needs.

JERGUSON GAGE & VALVE CO.

88 Fellsway, Somerville 45, Mass.

(Telephone listed under Jerguson Gage & Valve Co.)

Representatives in the Following Cities:

Appleton, Wis.
Atlanta 3, Ga.
Chicago 2, Ill.
Cleveland 14, Ohio
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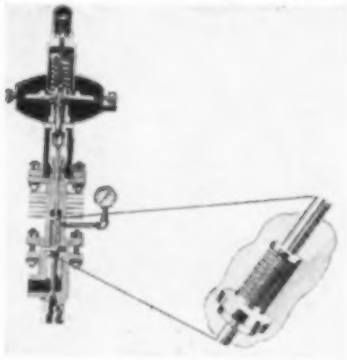
Detroit 4, Mich.
Houston 1, Texas
Kansas City, Mo.
Los Angeles 8, Calif.
Marshalltown, Iowa
Memphis 3, Tenn.
Minneapolis, Minn.
New York 17, N. Y.
Philadelphia, Pa.
Pittsburgh, Penna.
Montreal 13, P.Q. Canada
Portland, Maine
Portland 8, Oregon
San Francisco 4, Calif.
Seattle 9, Wash.
St. Louis 11, Mo.
Tulsa 12, Okla.
Mexico, D. F.

to varied and severe operating tests in the field for over three years without any failures, according to the manufacturer. The packless feature can be applied to any size or type of control valve made by this manufacturer, for



Bellows-sealed diaphragm control valve

working pressures to 500 psi. and any temperature between −70 and + 750 deg. F.

The new construction is recommended by the manufacturer for all applications where stuffing gland leakage cannot be tolerated, including the handling of toxic or dangerous fluids, high vapor pressure fluids, vacuum applications, and processes where extremely valuable fluids are handled. In the new valve the bellows is housed in a unit assembly which replaces the conventional valve bonnet. The bellows is protected from over-ranging by travel stops, while a conventional although modified packing gland is employed as an emergency seal should the bellows fail due to corrosion or mechanical fatigue. A telltale gage is provided to indicate bellows failure. This construction may be employed in three-way or internal-pilot, balanced-piston type valves as well as in standard constructions.

11. All-Steel Motor

A NEW LINE of all-steel welded squirrel-cage motors in sizes from 150 to 1,000 hp., four poles, with corresponding ratings for other numbers of poles up to 14, has been announced

Splash-proof, all-steel motor

Corkboard insulation holds these chambers within 1 degree of 50° F.

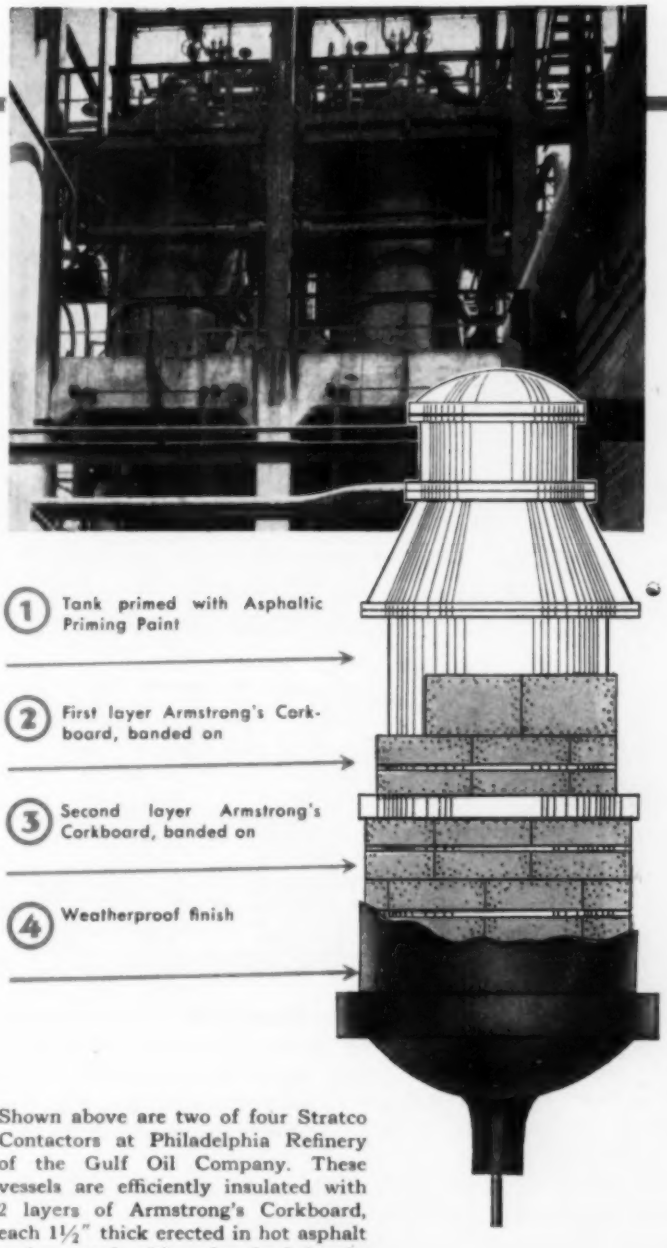
EXTREMELY accurate temperature control can be maintained in low-temperature processing chambers, indoors or out, when they're insulated with Armstrong's Corkboard. Applied in correct thickness, this material virtually eliminates the influence of outside temperatures.

Corkboard and cork covering are particularly efficient insulations in refineries. They have low thermal conductivity and high resistance to moisture. They are light in weight and fire-resistant. Successive layers bond together strongly. Cork can be given weatherproof finishes that have a high degree of fire resistance.

Cylindrical tanks, towers, and other vessels over 54" o.d. are efficiently insulated with Armstrong's Corkboard scored and bent to fit the contour of the vessel. Corkboard can readily be cut and fitted tightly over irregular shapes.

On cylindrical vessels under 54" o.d. and over 20" o.d., Armstrong's Corkboard Lagging and Discs are employed. And for piping and pipe fittings of all sizes from ¼" up, Armstrong's Cork Covering and Fitting Covers are recommended.

When maintenance of any temperature, low or high, adds to the efficiency of a process, it usually pays to insulate the equipment in which the process takes place. If you have a temperature-maintenance problem, talk it over with one of Armstrong's engineers. Just write to Armstrong Cork Company, Building Materials Division, 3304 Concord St., Lancaster, Pennsylvania.


1 Tank primed with Asphaltic Priming Paint
2 First layer Armstrong's Corkboard, banded on
3 Second layer Armstrong's Corkboard, banded on
4 Weatherproof finish

Shown above are two of four Stratco Contactors at Philadelphia Refinery of the Gulf Oil Company. These vessels are efficiently insulated with 2 layers of Armstrong's Corkboard, each 1½" thick erected in hot asphalt and secured with galvanized bands. 50° F. is held ± 1° in these chambers.

ARMSTRONG'S INDUSTRIAL INSULATION

Complete Contract Service For All Temperatures

From 300° Below Zero

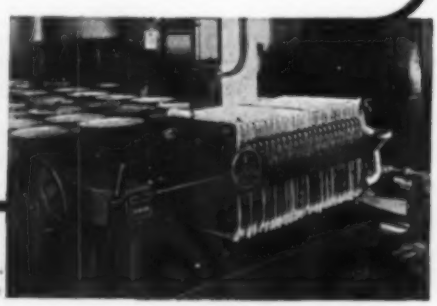
To 2600° Fahrenheit

Old Method or New Product? Here's a Guide to Better Filtration

If you're stymied in your process because the material makes filtration, clarification, washing, extraction or thickening slow and uneconomical with your present filter — If you're developing a product the filtration characteristics of which are difficult to determine —

Let this Shriver Filtration Guide and the Shriver Laboratory show you — free — how a Shriver Filter Press, versatile as to application, design, construction and capacity, can help lick your problem — no matter how difficult. Write.

SHRIVER FILTER PRESSES

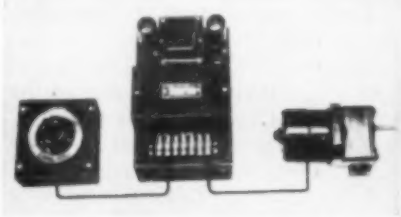


T. SHRIVER & COMPANY, Inc.
802 Hamilton St., Harrison, N. J.

by the Elliott Co., Jeannette, Pa. Known as the Fabri-Steel motor, this development is said to feature extreme rigidity of the motor frame, 10 percent lighter weight, 25 percent less space, and more efficient cooling. The use of thick steel plates coated inside and out with a rust preventive for the motor frames and brackets is said to eliminate trouble due to corrosion experienced ordinarily with sheet steel. The motor is designed for easy inspection and maintenance of the bearings. A full range of types, including drip-proof, splash-proof, forced ventilated, pipe- or base-ventilated, is available with either sleeve or antifriction bearings.

12. Remote Control Servo

An accuracy of better than 1 percent of full range, independent of the load, is claimed for the Synchro-Link remote positioning servo control now available from Yardeny Laboratories, 105 Chambers St., New York 7, N. Y. This device is a packaged type remote control for use with fractional or integral horsepower motors. Without modification it can be used for a large number of types of application

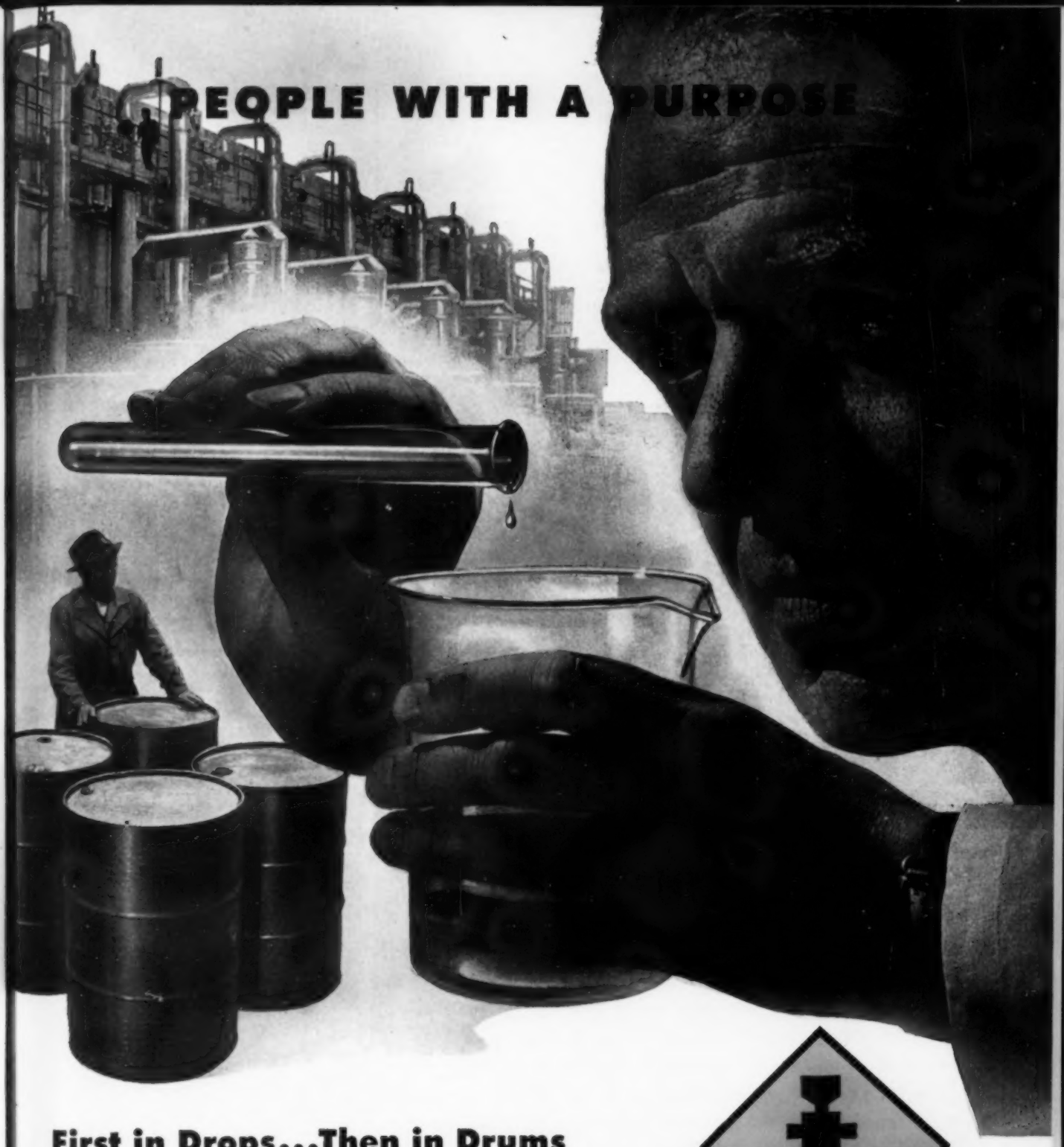


Synchro-Link remote servo control

in the control of variable speed transmissions, valves, dampers and other remotely positioned mechanisms. The device is a self-balancing electronic bridge including a master control with a knob and calibrated dial for manual control (or automatic control, if desired); the electronic controller proper; and a load control potentiometer geared to the motor or coupled to the load. Any reversible motor can be used. Turning the knob of the master control to a new setting causes the motor to follow at a predetermined speed. The device is equipped with a sensitivity control as well as an anti-hunting control for adapting the characteristics of the system to those of the load.

13. Transfer Pump

For low-lift service in delivering up to 15 g.p.m. at up to 90 turns per minute of the crank, Belco Industrial Equipment Division of Bogue Electric Co., 42 Iowa Ave., Paterson 3, N. J., has announced a hand-operated



First in Drops...Then in Drums

Just a few precious drops herald the production to come. Today in Oronite laboratories, research people are gathering the know-how to make more and better industrial chemicals available. Later, new chemical products will flow in quantity.

Here again is an example of the service Oronite will continue to render to manufacturers. Yesterday, today and tomorrow, you can look to Oronite for leadership in industrial chemicals.

ORONITE

CHEMICALS

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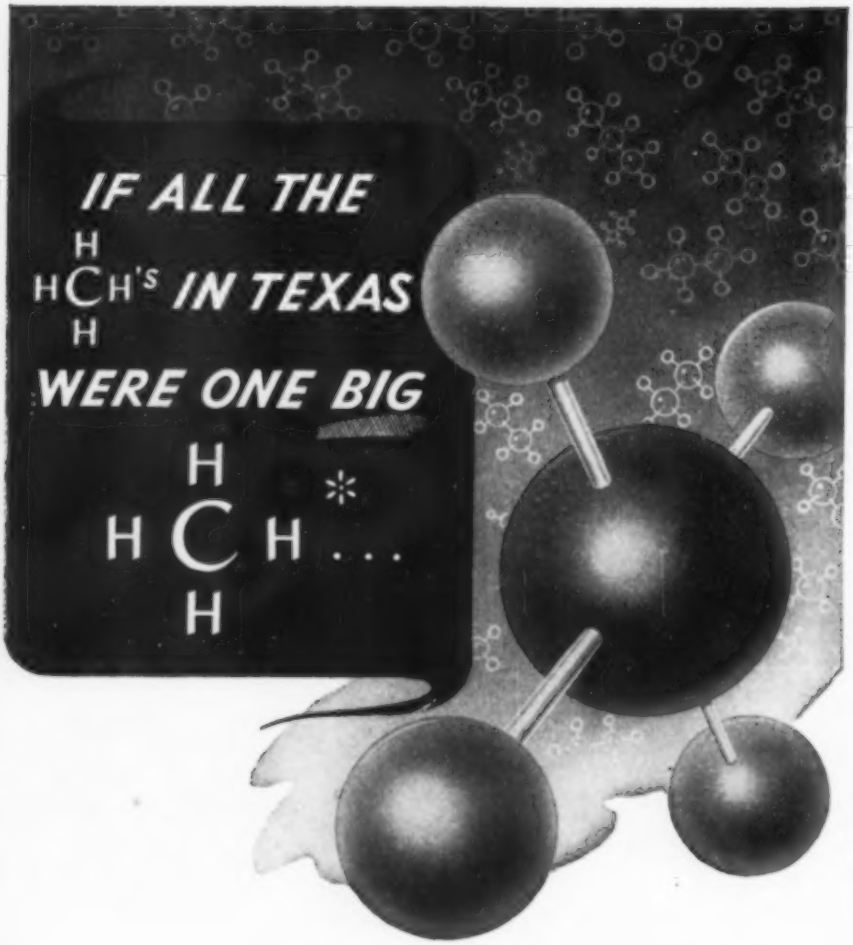


. . . you'd have some small idea of the possibilities awaiting the industrial chemist in Texas' Gulf Coast Country.

Some of the biggest names of the industry are already building new plants on the Texas coast. Others must come, soon or late. For Texas hydrocarbons — from Texas' abundant oil and superabundant natural gas (over 58% of U. S. reserves) — are the raw resource of a chemical development that has demonstrable advantages over plants located elsewhere.

See for yourself. Come down to visit us, or write us for specific information on the Texas Coast Country's advantages for your plant. Your request will be kept in confidence. Address Research Department, Houston Pipe Line Company, Houston, Texas.

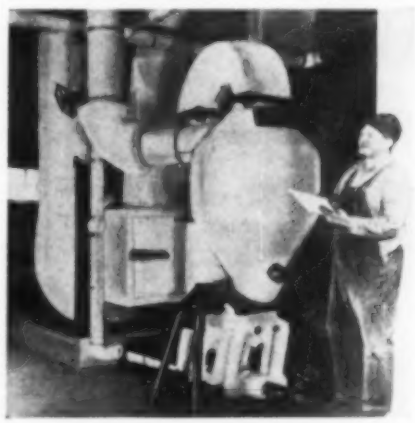
* *To paraphrase the old-time Texan's boast, "If all the steers in Texas were one big steer," etc.*

HOUSTON PIPE LINE CO.
Subsidiary of Houston Oil Company of Texas
GEO. A. HILL, JR., President
Wholesalers of Natural GAS

transfer pump of positive design. The rotor and shaft are supported on ball bearings sealed in grease to prevent contact with the liquid being pumped. The pumping element employs plastic vanes. Maintenance of prime is accomplished with a built-in check valve. The unit is designed for water, hydrocarbon liquids, petroleum products and similar materials although a specially constructed model is available for corrosive liquids.

14. Jet Pulverizer

EXCEPT for the feed screw, there are no moving parts in the new steam jet type fuel pulverizer recently announced by Blaw-Knox Division of Blaw-Knox Co., Pittsburgh, Pa. The pulverizer, which does not require the fuel to be dried, consists of a continuous loop containing a group of steam jets at one point and a centrifugal classifier at another. The feed, at a size not exceeding ½ in., is introduced by an adjustable feeder to an injection nozzle where a steam jet discharges it at high velocity against an anvil. The fuel is projected radially outward toward the walls of the classifier section, after which it travels downward into the pulverization zone where it is pulverized by superheated steam from several steam jets. From this zone the fuel particles are carried with the steam through an

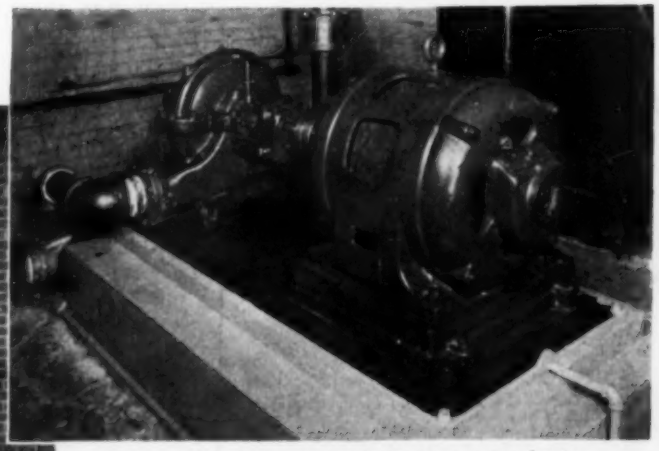


Steam jet pulverizer

uptake leg and back through the classifier where the previously pulverized fuel is classified according to size. Fine fuel at approximately 200 mesh is conveyed from the classifier and out of the mill by a flow of steam while oversize particles are rejected and recirculated with the incoming feed through the pulverizing zone. The exit stream is conveyed directly to the burners without intermediate storage or mechanical conveying.

The pulverizer requires no fan, is quiet in operation, is claimed to operate readily at peak as well as mini-

Over a Million Century Pump Motors in Service is



Century 50 horsepower squirrel cage motor driving an industrial pump.

Century 100 horsepower vertical motor driving a city water pump.

Century ½ horsepower vertical motor driving a farm water system.

Proof of Their Unusual Dependability, Satisfactory Performance

Century pump motors are driving all types of pumps that supply water — or other liquids — for farms, milk plants, food processing, factories, water works and irrigation projects.

One of the primary reasons for the exceptional acceptance of Century pump motors is that their starting and operating characteristics are particularly adapted to the operating requirements of pumping service.

In addition, Century motors are insulated to resist dampness.

Century motors are built in popular horsepower sizes for all pump applications—and for other industrial, commercial, and appliance applications.

Specify Century motors for all your electric power requirements.

Century C MOTORS

524

CENTURY ELECTRIC COMPANY • 1806 Pine Street, St. Louis 3, Missouri

Offices and Stock Points in Principal Cities

FOR BETTER BRAKE Performance

Consult Stearns Magnetic on your braking problems. Brakes in sizes up to torques of 500 lbs. or the equivalent of 100 hp. at approximately 1000 rpm. in floor or motor mounting types for AC or DC current. For effective retarding of motors or machinery, whether for one or a sequence of controlled stops, whether for horizontal or vertical mounting. Being satisfactorily used in hundreds of exacting operations.

Ask for our Brake Bulletin.

The magnetic brake with the lining wear indicator and manual release—distinctive, original.

STEARNS
MAGNETIC MFG. CO.
629 SO. 28th STREET MILWAUKEE, 4
SEPARATERS PULLEYS DRUMS CLUTCHES

mum loads and is said to make possible extremely low operating costs. Although used primarily for fuel pulverization up to this time, it is believed suitable for other materials as well.

15. Plastic Mixer

DESIGNATED as the Speed Densifier, a new mixing machine for use in the manufacture of plastics has been introduced by The Beardsley & Piper

Speed Densifier for plastics

Co., Special Applications Division, 4710 West Division St., Chicago 51, Ill. Without rolling or milling, the machine is said to mix and reduce the volume of the material in one simple operation, producing finished molding powder ready for grinding. It is claimed to mix, densify and completely saturate various types of fillers with dry or liquid resins and to coat uniformly fillers such as asbestos, mica or glass fibers which do not absorb resins. Certain rubber compounds are also suitable for use in the machine. Accurate time and temperature controls are provided to enable the heat and length of cycle to be duplicated from batch to batch. According to the manufacturer, perfect dispersion of from 1,000 to 6,000 lb. per hour can be obtained, depending on the material, with batches up to 300 lb. processed in from 2 to 4 minutes.

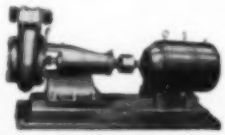
An additional advantage claimed for the new mixer is that it secures such thorough mixing that a smaller quantity of resin may be used to obtain the same results as with conventional processes, thus saving up to 5c. per pound.

Equipment Briefs

16. A NEW series if Micromet Feeders for the feeding of water treating chemicals for prevention of corrosion or scale has been developed by Calgon, Inc., Hagan Building, 323 Fourth Ave., Pittsburgh 30, Pa. The feeders

Plan with Peerless!

Peerless Centrifugal Pumps
(formerly Dayton-Dowd)
Meet extensive, continuous-duty pumping requirements in all Industries and Municipalities desiring advanced pump design, reduced operating cost and high pump efficiency.



Type DS CENTRIFUGAL PUMPS
For Chemical, Oil, Food Processing, etc.
Capacities: Up to 600 G. P. M. Heads to 230 ft.

Type XT TURBINE (Vane) PUMPS
For Butane-Propane, General and Process Work.
Capacities: Up to 150 G. P. M. For high heads.

Type A CENTRIFUGAL PUMPS
For General Services-Maximum efficiencies.
Capacities: Up to 60,000 G.P.M. Sizes: 2" to 42".

Type B BOILER FEED PUMPS
For High Pressures in Refinery, Pipe Line and Boiler Feed Services. Pressures up to 7001bs.

Type AF FIRE PUMPS
(formerly Dayton-Dowd)
Underwriters Approved. Capacities 500 to 2000 G. P. M. One of a Variety of Peerless Fire Pumps.

PEERLESS Pump Division manufactures an extensive line of high quality centrifugal pumps for usual or unusual pumping applications. The Peerless staff of highly trained engineers or field representatives will gladly assist you in prescribing the proper pump for your specific application. If you are considering a pump installation demanding long range, trouble-free service, then Plan With Peerless—It will pay!

PEERLESS PUMP DIVISION
FOOD MACHINERY CORPORATION
Factories: 301 W. Ave. 26, Los Angeles 31, California: Quincy, Ill.; Canton 6, Ohio—District Offices: Canton 2, Ohio; Ardmore, Pa.; Decatur, Georgia; Dallas, Texas
Distributors in Principal Cities

SIMPLIFIED *Process Heating*

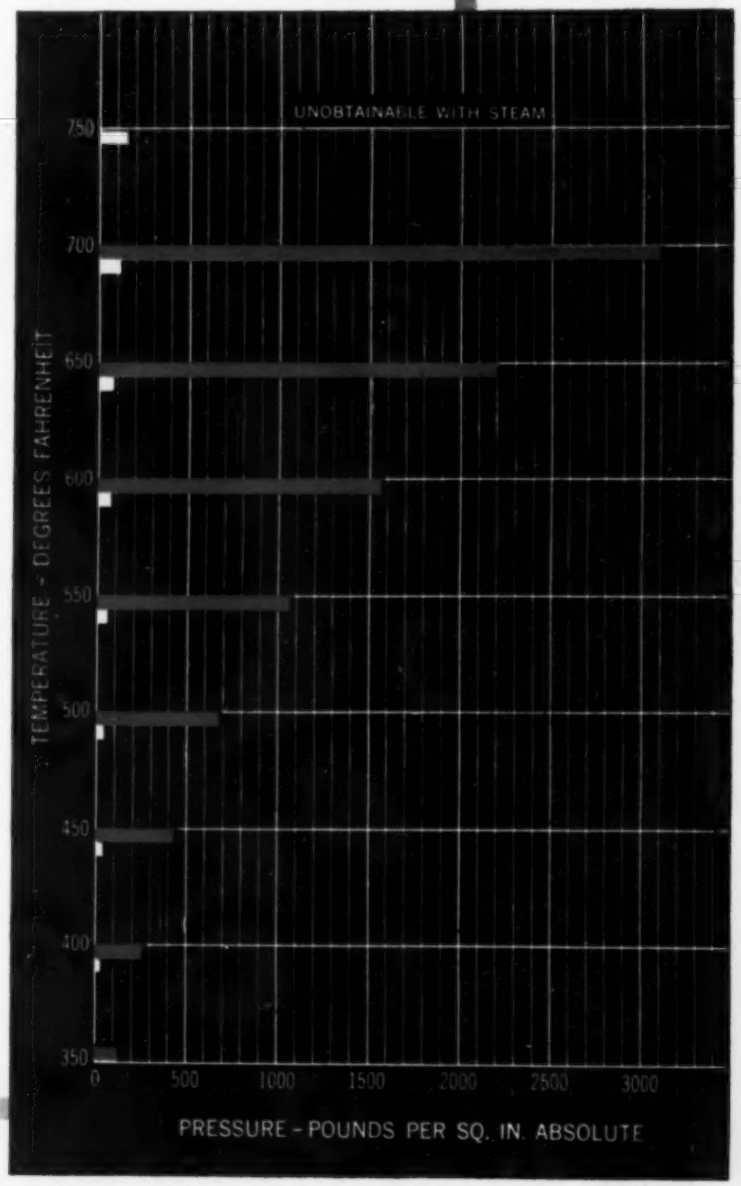
GIVES HIGH TEMPERATURE (700°) AT LOW PRESSURE (88 lbs.)

Evaluate in terms of your present processing method what uniform temperature, high rate of heat transfer, and close control of temperature mean. Add to this the factors of simplified design, permitting you to heat and cool in the same cycle; safety and simplicity in operation; and low maintenance of equipment.

A Foster Wheeler Dowtherm heating system will give you all these advantages, and in addition improve the quality of your product.

If you are looking for greater operating economy, find out what this modern high-temperature low-pressure method can do for you. Address

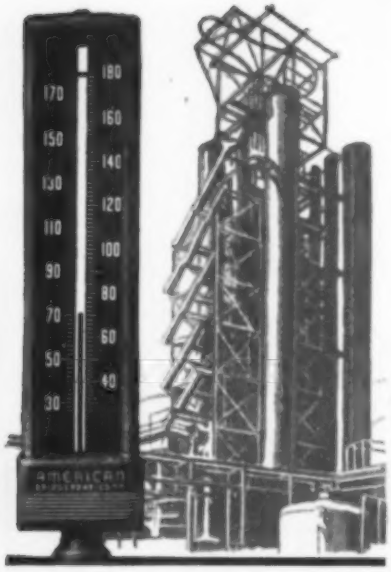
FOSTER WHEELER CORPORATION
165 BROADWAY, NEW YORK 6, N. Y.



TEMPERATURE-PRESSURE COMPARISON
Dowtherm ▭ Steam ▬

This chart gives a direct comparison between pressures in FW Dowtherm heating systems and those encountered in steam systems for the same working temperatures.

FOSTER WHEELER



Which thermometer?

FOR industrial use in the chemical industry, American Thermometers have won a reputation for enduring accuracy that has survived generations and is more dominant today than ever.

Quick, easy reading is achieved by the broad stripe of red-reading mercury, the clean-cut universal scale, the wide-angled construction that admits maximum light through glareless glass and the case which is dust- and damp-proof.

Tell us your requirements. We will recommend the best thermometer for your purpose. Write for catalog.

American Glass, Dial and Recording Thermometers are sold by leading distributors everywhere. Write to them or to us for information

AMERICAN
Industrial Instruments
A Product of
MANNING, MAXWELL & MOORE, INC.
BRIDGEPORT 2, CONNECTICUT
Makers of 'American' Industrial Instruments, Hancock Valves, Ashcroft Gauges, Consolidated Safety and Relief Valves,

cover the range from 3,000 to 1,000,000 gal. of water per month and hold varying quantities of Micromet chemical ranging from 20 to 100 lb. The chemical dissolves slowly at the rate of 25 percent per month so that only that much of the initial charge needs to be renewed each month. This chemical, a modification of Calgon, is said to be used in more than 600 municipal water systems and in many industrial installations to prevent lime scale and to control corrosion. The largest feeder of the line will handle up to 1,000,000 gal. per month, and the smallest, as low as 3,000 gal. The treating chemical, which inhibits scale and corrosion without attempting to soften the water fully, is said to have no effect on taste or potability of the water.

17. PITTSBURGH Lectrodryer Corp., Pittsburgh, Pa., has announced that the unit-type automatic air dehumidification machines which this company developed for the Navy's fleet preservation program—otherwise known as "Operation Zipper"—are now available to private industrial users. Employing activated alumina as the dehydrating agent, this equipment incorporates automatic cycling apparatus, and automatic electric heat for regeneration. As an indication of investment and operating costs for industrial use, the Navy Department's figures are of interest. The Navy found that the installed equipment cost was in most cases less than 1c. per cubic foot of volume to be dehumidified and that power costs ran well below 15c. per 100,000 cu. ft. of dehumidified volume per day at 1c. per kw.-hr.

18. Two NEW jet motors for tube cleaning, said to be the most powerful and efficient ever built, have been announced by the Roto Division of the Elliott Co., Newark 1, N. J. One type is operated on air, the other on water. The air motor can be adapted to operate on steam pressure. Despite reduction in air consumption per horsepower of 60 to 80 percent, these new motors are said to develop from 100 to over 250 percent more power than previous Roto motors. The air motor is extremely simple, having only two moving parts, a shaft and a blade. The water type features a radical change in turbine wheel design. Increase in power and reduction in water consumption comparable to the air model is claimed.

19. CLOSER temperature control and longer life are claimed for an improved design of thermocouple introduced by Arklay S. Richards Co., 66 Winchester St., Newton Highlands 61, Mass. The

CASE HISTORY No. 14

One in a series of factual experiences of a group of American manufacturers with Multiwall Paper Bags.

COST COMPARISON (Per Ton)

FIBRE DRUMS

MULTIWALL BAGS

CLASS OF PRODUCT PACKED

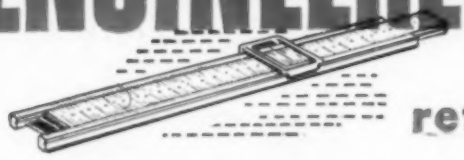
CEMENT	FERTILIZER
CHEMICALS ✓	FOOD
FEEDSTUFFS	MISCELLANEOUS

PRODUCT CHARACTERISTICS

ABRASIVE	GRANULAR
CORROSIVE	HEAVY
DELIQUESCENT	HYGROSCOPIC
FLUFFY ✓	LIGHT ✓
FREE-FLOWING	VISCOUS

ST. REGIS PACKAGING SYSTEMS are designed to meet a wide range of product requirements and plant layouts. Packers are available in a variety of sizes and types, with filling speeds as high as twenty-four 100-lb. bags per minute—with one operator. Nearly 400 commodities—rock products, fertilizers, chemicals, foods, and feeds—are now being packaged in sturdy, low-cost multiwall paper bags.

ENGINEERED PACKAGING



returns substantial saving

for chemical division of *United States Rubber Company*

In the Naugatuck Chemical division of United States Rubber Company packaging methods are carefully engineered. Continuous cost studies make certain that packaging output and labor and container costs meet strict standards of efficiency and economy.

A few years ago company engineers noted a steady rise in the cost of packing in fibre drums of two high-priced chemicals — anti-oxidants and accelerators used in rubber compounding.

After a thorough investigation of packaging costs the company installed two St. Regis 100-LS bag-filling machines at its Naugatuck, Conn. plant and switched to 50-lb. multiwall paper valve bags. Soon after, analytical cost studies disclosed these results:

- **Reduced container costs per ton of material packed**
- **Reduced man hours required to pack, handle, and store the material**
- **50% to 70% reduction in over-all packaging costs**

In addition, company engineers reported that Multiwalls gave efficient protection against contamination of these expensive chemicals . . . reduced dust in packaging . . . saved storage space . . . and won general acceptance from customers.

This case history is another striking example of how St. Regis Packaging Systems provide efficient and economical packaging. For complete details, mail the coupon for free copies of an illustrated folder.

LEFT: *Only one operator is required for each valve bag packing machine.*

ABOVE: *Filled Multiwall bags stacked in the company's warehouse.*

MULTIWALL

ST. REGIS SALES CORPORATION

(Sales Subsidiary of St. Regis Paper Company)

NEW YORK 17: 230 Park Ave. CHICAGO 1: 230 No. Michigan Ave.
BALTIMORE 2: 1925 O'Sullivan Bldg. SAN FRANCISCO 4: 3 Montgomery St.
ALLENTOWN, PA.: 202 Penn Bldg.

Mail this coupon for the complete story

OFFICES IN OTHER PRINCIPAL CITIES — IN CANADA:
ST. REGIS PAPER CO. (CAN.) LTD., MONTREAL, VANCOUVER

Without obligation, please send me full details regarding "Case History" No. 14 outlined above.

NAME_____

COMPANY_____

ADDRESS_____

couple is supplied in either an 8 ga. standard Chromel-Alumel, or in an iron Constantan type. A seamless-drawn Inconel protective tube fits the element closely to give maximum sensitivity of response, while long life is said to be assured by the use of an unusually heavy wall thickness for the protecting tube.

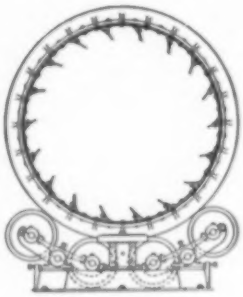
20. For a variety of heating applications requiring a portable flame producer, including not only weed burning but also metal heating and general repair work, the Aeroil Products Co., 5701 Park Ave., West New York, N. J., has introduced the Aeroil-Schramm power burner, consisting of a gasoline-powered compressor and the necessary fuel supply tanks mounted on a trailer, together with two burners supplied with air and fuel hose. By regulating the air and fuel valves any type and length of flame can be produced from 6 in. to 15 ft. long, at temperatures up to 2,000 deg. F. No special fuel is required since the burner will operate on kerosene or any oil up to No. 3 fuel oil.

21. Less space for the same capacity, as compared with sand filters, is claimed for the Pur-O-Cel filter put on the market by Proportioneers, Inc., 29 Codding St., Providence 1, R. I. This new water filter, which is also suitable for oils, sirups, liquid soaps and a variety of other liquids, makes use of thin mats of diatomaceous earth as the filtering medium. Backwashing for cleaning is said to be easily accomplished without disassembling the unit and with a comparatively small volume of water.

22. For use where nuisance or harmful dust affects the eyes as well as the respiratory system, the Mine Safety Appliances Co., Pittsburgh 8, Pa., has introduced the Fulface dust mask which combines complete facial and respiratory protection against dust in one unit. The mask covers the entire face and conforms snugly to facial contours. Low breathing resistance is presented by the twin large-area, throw-away filters which are inexpensive and easy to replace. A single large clear plastic lens permits wide angle vision.

23. As a power supply for Geiger counters, a new Eveready dry battery supplying 300 volts and weighing only 1 lb. has been developed by National Carbon Co., 30 East 42nd St., New York, N. Y. Three such batteries, designated as No. 493, can be used in series to operate portable radioactivity meters. When used daily for an average of 4 hours per day, the battery life is estimated at 350 hours.

DRYERS
for
EVERY
APPLICATION



The "XF" Dryer,
for example . . .

The Hardinge Ruggles-Coles Class "XF" Dryer, shown here in cross section, is particularly adapted for drying materials of low moisture content, using inexpensive fuel.

A single-shell, direct-heat dryer —built for severe service—it can be arranged for parallel flow of combustion gases and drying material to handle products which must be dried at less than 212°F — or it can be arranged for counter flow, to heat materials above 212°F.

A special feature of the counter-flow model is the discharge of dried materials *before* they pass through the furnace.

The "XF" Dryer is only one of the *nine* different types of dryers manufactured by Hardinge for the process industries.

Write for Bulletin 16-C, describing the complete Hardinge line of dryers, kilns, and coolers.

HARDINGE
COMPANY INCORPORATED
YORK, PENNSYLVANIA — 240 Arch St. • Main Office and Works
NEW YORK 17—122 E. 42nd St. • 200 W. Wacker Drive—CHICAGO 6
SAN FRANCISCO 5—501 Howard St. • 200 Bay St.—TORONTO 1

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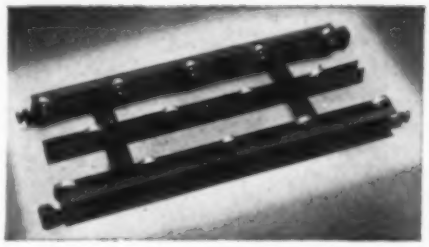
OUTSTANDING
ADVANTAGES
OF
STREAMLINER
ENGINEERED
CONVEYOR
SYSTEMS



WHEEL CONVEYORS—designed specifically for your needs.

STRONGER BOX CONSTRUCTION—to assure greater load per section.

LOCKED INNER WHEEL RACE —(equipped with free-rolling ball bearing wheels)—that does not creep or cut shafts.

LOCK NUTS USED THROUGHOUT — vibration cannot loosen wheels or nuts.

EASY TO REPAIR — no special parts or shafts. Repairs can be made in your own shop.

SPACING OF ROLLS CAN BE CHANGED QUICKLY—all flats are punched on 3" centers and additional wheels can be added as needed.

LIGHT IN WEIGHT for easy handling.

Our experience of more than 25 years' is at your service to help solve your materials handling problems. Write for detailed information.

HARRY J. FERGUSON CO.
WHEEL • PORTABLE BELT • BELT AND ROLLER GRAVITY CONVEYORS
117 WEST AVE., JENKINTOWN, PENNA.

NEW PRODUCTS AND MATERIALS

Richard W. Porter, ASSISTANT EDITOR

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FOR MORE INFORMATION
See Reader Service
Coupon on pages 157-158

51. Coating Resin

NEWEST member in its 200 series of resins, Durez 240 is now being produced by the Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y. Durez 240 resin has a high melting point, bodies soft oils rapidly, and makes varnishes that dry to a full rich gloss with good flexibility. This new material is useful in varnishes, alkyd resins, printing ink vehicles, and emulsion waxes. It is capable of entering into the reaction in the preparation of an alkyd resin. It will increase hardness and speed of set and will decrease water susceptibility. In industrial finishes its action is good and it will yield a clear solution with coal tar or petroleum solvents. Durez 240 is said to produce excellent gloss ink vehicles by decreasing penetration into paper stock. It may be blended with carnauba and candelilla waxes to produce wax bases for "self-polishing" or "no rub" emulsion waxes.

52. Powdered Silica

BY MEANS of an improved process, a powdered silica so fine that a cubic inch contains 500 billion particles is now available from the Monsanto Chemical Co., St. Louis, Mo. Used as a gloss reducing agent for lacquers and varnishes, Santocel imparts a desirable sheen to furniture, rather than a high gloss, that brings an improvement in mar and burnishing resistance. The particles of silica are porous and sponge-like and contain 94 percent air.

Monsanto Chemical Co's. improved gloss reducing agent, Santocel, is a powdery silica whose particle size averages about 4 microns in diameter

Formerly, Santocel powdered silica contained approximately 537 million particles per cu.in. These particles, however, were too large to permit thorough dispersion in finishes in a sufficiently short time. The finer size of the new Santocel improves this. Magnified to the size of a baseball, a particle of the new powdered silica resembles a sphere of cotton batting. Individual fibers have a probable diameter of from 25 to 35 angstroms. Santocel is produced by removing the liquid from a jelly-like silica substance without shrinking of the solid structure.

53. Obsidian Construction Material

Now being produced in limited quantities by Continental Basic Materials Corp., San Diego, Calif., is a new type construction material, known as CBM, produced from thermally expanded high-purity obsidian similar to perlite but with little or no moisture content. Produced in five sizes ranging from a white powder to fluffy white granules 0.75 in. diameter, Continental Basic Material, when mixed with cement in the proper proportions, is claimed to have 2.5 times the strength of sand-and-cement, one-third the weight, four times the insulating value, virtually no capillary attraction and fireproof rather than fire-resistant qualities. Aside from bricks, plaster and cement, it has already been used experimentally in storage tanks, floats, firebrick, tile, wallboard and pipe coverings. Since it may be used in almost any proportions, it is thought to have possibilities as a plastics filler.

54. Outdoor Surface Coating

PROTECTION for roofs and other structural surfaces exposed to extreme summer temperatures can be obtained by use of a new coating developed by the California Research Corp., a subsidiary of Standard Oil Co. of Calif., 225 Bush St., San Francisco, Calif. This coating, brushed or sprayed on a surface in the form of a dark brown liquid, immediately turns to a silver color as aluminum particles held in suspension in the coating's asphaltic base, rise to the surface. This results in a continuous cohesive metallic film on the surface which reflects heat, to give cooler building interiors. Its appearance is the glossy luster of aluminum without the reflection glare of conventional aluminum paint. It has been tested under various conditions for a

Molded with cement, obsidian construction material floats on water

CONTROLLING CORROSION IN STREPTOMYCIN PRODUCTION . . .

*Purification Equipment

*Fermented Broth Tanks

When the engineers for a leading pharmaceutical company designed the first large scale streptomycin plant, they knew they faced critical corrosion and contamination problems. For equipment, they used rubber lined tanks and porcelain pipes, with pumps and filters of special alloys. *To stop corrosion from spills, drips and fumes, they used Prufcoat Protective Coatings.*

This is one more example of the way Prufcoat teams up with the other good materials available to the chemical process engineer interested in controlling corrosion and contamination.

*Extraction Units

APPLIED BY BRUSH...BY YOUR OWN MAINTENANCE CREW

Prufcoat is a special formulation of synthetic resins that air-dries by evaporation of the volatile solvents. One material for application to all surfaces — concrete floors, walls, ceilings, structural steel, tanks, pipes, ducts, machinery and equipment. Available in a variety of standard colors for identification of lines or equipment, Prufcoat costs only slightly more per gallon than ordinary paint, costs no more to apply, and has been performance-proved in America's leading chemical process industries, including Hanford and Oak Ridge.

The Prufcoat film formed after polymerization has virtually a zero acid number, saponification number and water absorption rate.

Write today for descriptive bulletin. Prufcoat Laboratories, Inc., 63 Main Street, Cambridge, Massachusetts. Sales Office: 50 East 42nd Street, New York City.

PRUFCOAT
PROTECTIVE COATING

SPECIFICATIONS
✓ Acid-Proof
✓ Alkali-Proof
✓ Alcohol-Proof
✓ Oil-Proof
✓ Water-Proof
✓ Flame-Proof

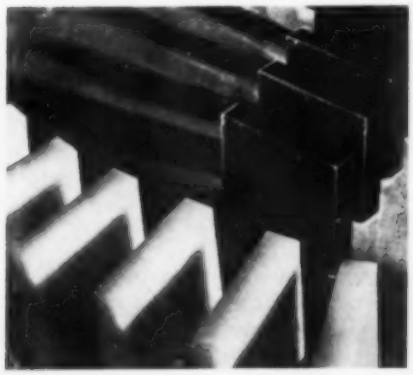
Applies like paint to masonry, metal, wood

*Photographs courtesy Merck & Co., Inc. Elkton, Va.

number of years, but has remained unchanged under conditions that have caused other roofing materials to deteriorate rapidly. The new coating is expected to be placed on the market in commercial quantities in the near future.

55. Micro-Crystalline Wax

HAVING been tested in various applications during the past year, a new micro-crystalline type wax is now commercially available from the Sun Oil Co., 1608 Walnut St., Philadelphia 3, Pa. Known as Sunwax 1290, this new material is a relatively hard, non-brittle, non-sticky petroleum wax. Having a melting range of 175 to 185 deg. F., Sunwax is made in both yellow and



Sunwax 1290 is a micro-crystaline wax having high melting point and high tensile strength and is available in yellow and brown grades

brown grades. Individual crystals of Sunwax 1290 are extremely small, making a highly uniform film or layer of the product which provides good protection against the passage of moisture.

This material is claimed to be well suited for the protective lining of paper, wood or metal containers where contact between the contents and container wall is undesirable. It is also effective as a lining for beverage containers. Another application where this material has been tried includes use in the fabrication of electronic coils and paper wrapped condensers, in the coating of paper, in the waterproofing of dynamite fuses.

56. Sorbic Acid

Now available in development quantities from Carbide & Carbon Chemicals Corp., 30 East 42nd St., New York 17, N. Y., is 2-4-hexadienoic acid, more commonly known as sorbic acid. Of interest as a chemical intermediate in the vegetable oil, synthetic resin and pharmaceutical industries, sorbic acid is a white, crystalline solid with a purity of 99 percent by weight

CUT HIGH OPERATING COSTS... DURING THE WARM MONTHS!

Get Low-Cost HOT WATER with CHROMALOX Electric Circulation Heaters

Efficient CHROMALOX *Electric* Heaters eliminate expensive coal or oil fired steam-boiler operation during the months boilers are not used for plant heating.

These easy-to-install Heaters connect to the water tank . . . or directly to water-utilizing equipment for "made-on-the-spot" hot water. Automatic or manual controls assure a plentiful and dependable supply at low cost.

CHROMALOX Circulation Heaters are also used for pre-heating cheaper fuel oils, heating oil-jacketed processing equipment and superheating steam. In fact, these and many other CHROMALOX *Electric* Heaters can do hundreds of heating jobs in your plant *more efficiently* and *at less cost*.

THESE ADVANTAGES ARE YOURS WITH CHROMALOX ELECTRIC HEAT

1. EFFICIENT heat when and where you need it.

2. ECONOMICAL initial cost, low operating and maintenance costs.

3. ACCURATE temperature control holds heat within desired limits, maintained thermostatically or manually.

4. WIDE SELECTION to meet your specific heat requirements.

5. PROVED performance in the shops, laboratories and offices of leading industrial plants.

6. BETTER process, production and product—uniformly high in quality.

7. NATION-WIDE organization of Application Engineers to give you practical "on-the-job" assistance.

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faster cleaning

For

STAINLESS STEEL EQUIPMENT

If quick cleaning is one of the factors that determines your use of stainless steel processing equipment, remember this:

A STAINLESS STEEL VESSEL WITH ROUND CORNERS CLEANS FASTER—MORE THOROUGHLY—THAN ONE WITH *SQUARE* CORNERS. Whether you clean with brush or cloth—you can "get at" all the surfaces of a round-cornered vessel easily. There are no corners in which residue can hide.

Having worked exclusively with stainless steel and alloys for many years, we have developed to a high degree the techniques needed to fabricate processing equipment with round corners.

Using tools and dies of our own design, we build your vessels so that cleaning time in your plant is cut to a minimum. Result: your stainless steel equipment costs less to operate and lasts longer. Consult with us.

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S. BLICKMAN, INC.
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SEND FOR THIS VALUABLE BOOK

A request on your letterhead will bring our guide, "What to Look For When You Specify Stainless Steel for Your Processing Equipment."

CORROSION RESISTANT PROCESSING EQUIPMENT

TANKS • KETTLES • STILLS • HEAT EXCHANGERS • AGITATORS • MIXERS • TOWERS • PIPING

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on a dry basis. The acid as shipped contains a maximum of 10 percent by weight of water to prevent polymerization on long standing. It melts at 134.5 deg. C. and boils with decomposition at 228 deg. C. It is soluble in many organic solvents and although it is only slightly soluble in water, its alkali salts dissolve readily. A promising application of this material is its use in upgrading or improving natural drying oils. Soft oils such as soya may be improved to obtain the properties of linseed; linseed oil itself may be upgraded to the equivalent of tung oil. Even the properties of tung oil are claimed to be improved by sorbic acid treatment.

Sorbic acid undergoes the reaction typical of acids, and the metallic salts, esters, acyl halides, amides, and anilides, are easily prepared. In addition to its normal behavior as an acid, it takes part in reactions characteristic of compounds containing a conjugated system of double bonds. It is available in 1-gal. fiber containers containing 3.4 lb. and in 20-gal. fiber containers containing 100 lb. Its physical properties are given in the accompanying table.

Physical Properties of Sorbic Acid

Molecular weight	112.06
Melting point, deg. C.	134.5
Boiling point, 2 mm. Hg, deg. C.	100
30 mm. Hg, deg. C.	150
760 mm. Hg, deg. C.	228 (with decomposition
Ionization constant at 25 deg. C.	1.73×10^{-5}
Flash point (open cup) deg. F.	approx. 260
Solubility in water at 20 deg. C., percent by wt.	approx. 0.2
in water at 100 deg. C., percent by wt.	3.8
Solubility in g. of sorbic acid, per 100 g. of solvent at 20 deg. C.	
Acetone	10.13
Benzene	2.36
Carbon tetrachloride	1.29
Cyclohexane	0.28
Dioxane	13.32
Ethanol	11.31
Glacial acetic acid	13.00
Isopropanol	9.13
Methanol	14.78
Methyl acetate	6.49
Toluene	1.90

57. Anti-Static Powder

A POWDER that can be blown into automobile inner tubes to reduce static shock and car radio static will soon be available for motorists according to an announcement by the United States Rubber Co., Rockefeller Center, New York. Developed by this company prior to the war, this powder was an outgrowth of research on conductive rubber tires for industrial trucks and tractors. Such tires were developed espe-

A trademark worth remembering

NEVILLE

- Coumarone Resins
- Alkylated Phenol Resins
- Plasticizing Oils
- Coal-Tar Solvents
- Neutral and Shingle Stain Oils
- Rubber Reclaiming Oils
- Chemical Specialties

THE NEVILLE COMPANY
PITTSBURGH, 25, PA.
Chemicals for the Nation's Vital Industries

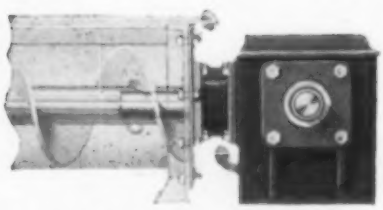
A-23

Continental Screw Conveyors and Elevators handling material to storage and from storage to mill.

If it's a

SCREW CONVEYOR PROBLEM—

Specify CONTINENTAL



Continental Screw Conveyors are the answer to many handling problems, providing a compact, efficient, economical unit for handling many materials. They require a minimum of space, operate on any plane, can receive or discharge materials at various points, and can be made dust-tight.

In planning your Screw Conveyor system, specify Continental Helicoid, Sectional or Ribbon Conveyor, Hangers, Box Ends, Conveyor Trough, Vertical Screw Elevators. Also Manufacturers of Belt Conveyors and Bucket Elevators.

INDUSTRIAL DIVISION

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cially for munitions plants and other places where static electricity might easily cause fires and explosions. Static electricity is often evidenced in automobiles through annoying clicks in radios or through electric shocks received by persons when stepping in or out of a car. This electricity is built up by the moving tires of the automobile and is affected by weather conditions and road surfaces. About one tablespoonful of this powder is injected into each tube after the tube has been deflated and its valve core removed. The powder tends to cling permanently to the walls of the tube for the duration of the tube's life, modifying the electrical behavior of the tire and tube to eliminate or greatly reduce static troubles.

58. BLACK METAL FINISH

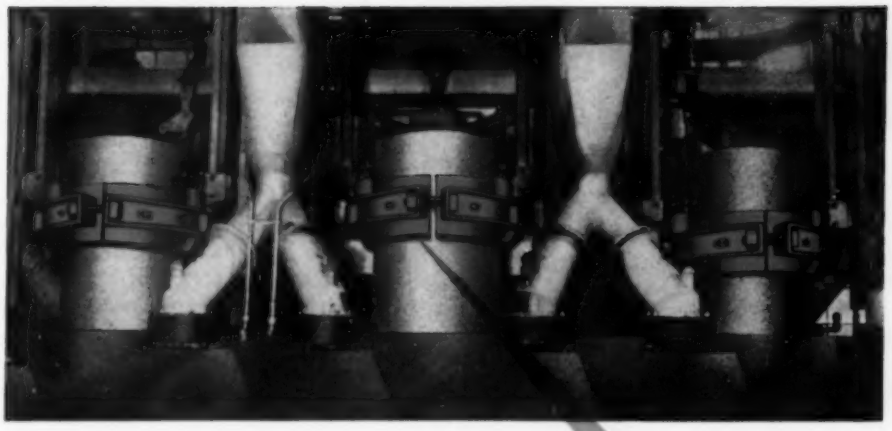
KNOWN as DC oxidizing compound is a new product for producing uniform black finish on steel parts. Announced by D. C. Cooper Co., 1467 South Michigan Ave., Chicago 5, Ill., this material is claimed to produce a black surface in 5 to 15 min. in a single bath application. Application is said to be simple, fast and economical and may be used instead of painting or plating. It is recommended for use on machine parts, saws, bearings, screws, and a wide variety of steel parts.

59. THIOPHENE DERIVATIVES

RESEARCH quantities of four derivatives of thiophene are now available from the Arapahoe Chemicals, Inc., Boulder, Colo. These are as follows: 2-chloromethylthiophene, 2-thiophenealdehyde, thiophene-2-carboxylic acid, and 2-thienylmagnesium bromide. These derivatives of thiophene are claimed to show promise in the field of pharmaceutical chemistry. They are available in quantities not exceeding one kilogram at the present time. Shipments of larger quantities will be possible in a few months.

60. FLAME RESISTANT VINYL YARN

SOON to be available in semi-commercial quantities from Carbide & Carbon Chemical Corp., 30 East 42nd St., New York, N. Y., a new vinyl yarn is now produced from a resin which results from the copolymerization of vinyl chloride and acrylonitrile. This new yarn has dimensional stability in boiling water and can be readily dyed dark and brilliant shades in a wide range of the usual synthetic fiber colors. It is claimed to have high strength and good resistance to many chemicals. It will not support combustion, is water resistant, and is un-



3 N-B-M Electrode Holders applied to 40-inch carbon electrodes in a TVA 13,000 KW furnace unit producing phosphorus at Wilson Dam, Alabama.

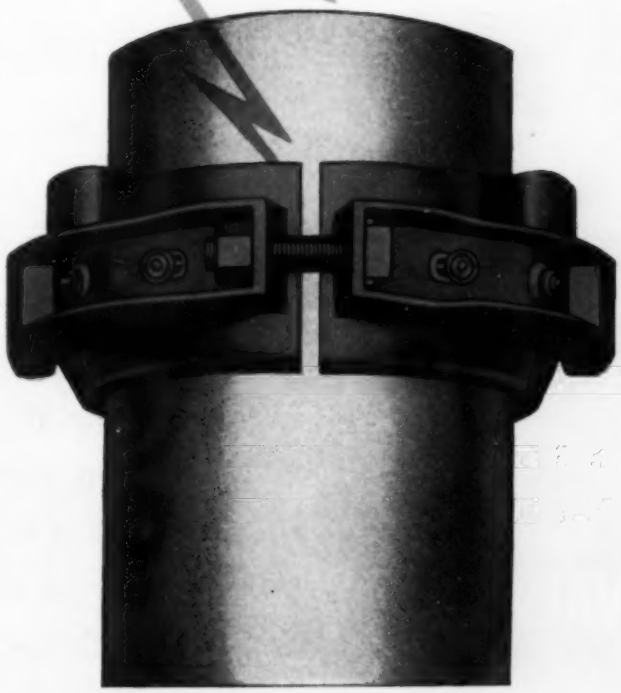
N·B·M ELECTRODE HOLDERS INCREASE CONDUCTIVITY... SAVE UP TO 500 KW

• Special copper alloy combines tighter gripping strength with higher thermal and electrical conductivity.

To overcome the wasteful resistance between holder and electrode, N-B-M has perfected an extremely dense, non-porous copper alloy. It permits tightest contact with maximum conductivity. All water-cooled castings are carefully tested under high hydrostatic pressure.

N-B-M Electrode Holders fit all types and sizes of carbon or graphite electrodes, for the production of phosphorus or carbide, in furnaces of low or high KW rating

Tell us your requirements—we can help you save substantially on power and maintenance costs.



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P O T P

The "Proof of the Pudding" that Amersil's new engineering service pays off in practice, in large or small plants, having problems involving extreme temperatures and highly corrosive operating conditions is illustrated by the case histories shown.

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Ask an Amersil engineer to explain the new integrated engineering service which includes development, research, design, controlled manufacture of major silica ware units, selection and purchase of auxiliaries—all under one contract one responsibility.

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affected by micro organisms and insects. The natural color of this material, known as Vinyon yarn, Type N, is light gold, but it is expected that a completely white yarn will be produced. Because of its properties, this yarn should be adaptable to new textile applications. Some applications under study include full fashioned hosiery, rain and sportswear, filter fabrics and sewing thread. It has high strength and abrasion resistance and should prove useful for nets, draperies, rugs and upholstery fabrics.

61. Labeling Adhesives

DEVELOPED by National Starch Products, Inc., 270 Madison Ave., New York 15, N. Y., is a new, all purpose labeling and protective coating adhesive. Known as Resyn Adhesive Q3605, this material is claimed to be suitable for all types of containers and is used where positive and permanent identification is necessary for labels on metal drums, glass bottles and other containers. It acts both as an adhesive and as a protective label coating.

62. Tire Releasing Compound

AN ADDITION to its family of degreasing agents, solvents and detergents is a new tire releasing compound made by Gaybex Corp. P. O. Box 3, Nutley 10, N. J. Developed to permit easy removal of truck, bus and airplane tires which become bonded to wheel rims, this material, applied to the tire at the rim junction, is claimed to penetrate and break the bond in a matter of several minutes. G-Pen TR, as it is called, is non-flammable, non-toxic, and is available in 1-, 5- and 64-gal. containers.

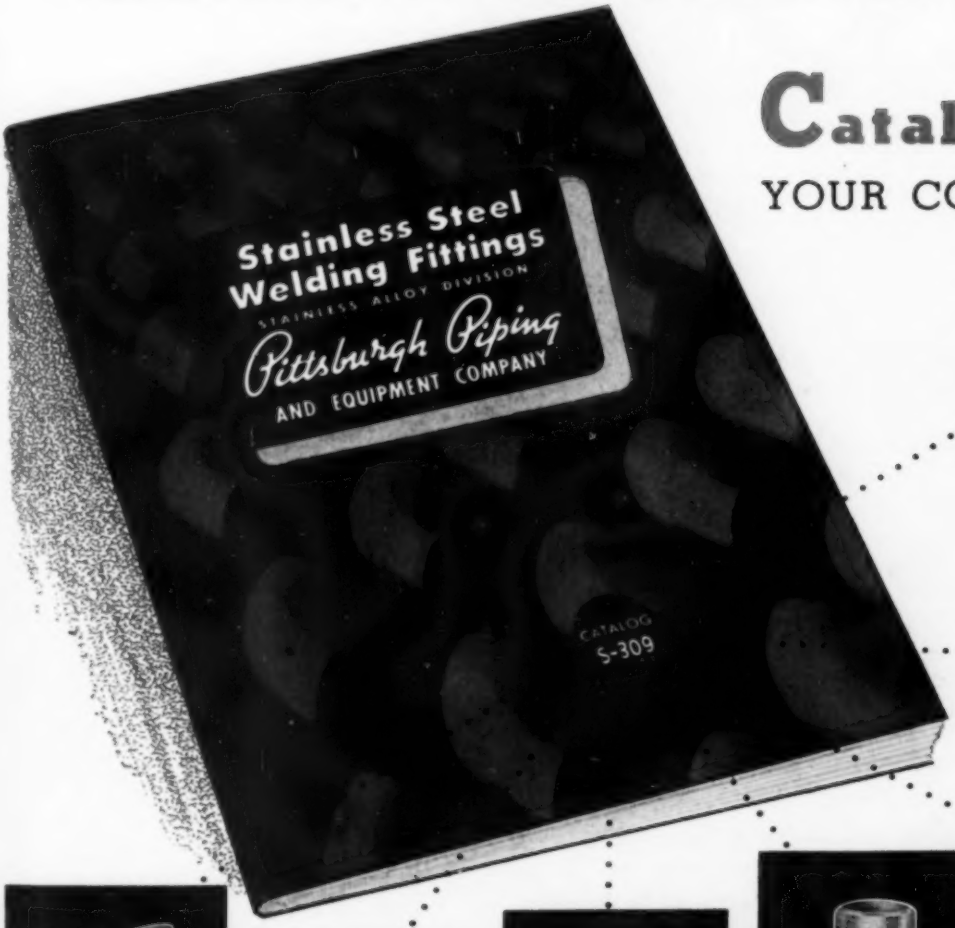
63. Wetting Agent for Gummed Tape

RECENTLY announced by Service Industries, 2103 East Somerset St., Philadelphia 34, Pa., is a new product called Stick-Gum for improving the stickiness of gummed tape. Containing a bacteriacidal agent, this material not only makes gummed tape stick better, but prevents bacterial growth which might occur in the glue or adhesive. It is claimed to be useful for mixing dry glue in place of water and will speed up mixing, increasing the pentrating power of the adhesive solution, as well improving the holding power.

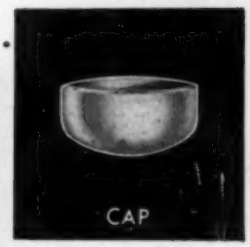
64. Lacquer Undercoat

FOR use as an undercoat for applying to aluminum and aluminum alloys which are to be painted or lacquered, is a new material called Prepaint,

Complete *line of*
STAINLESS STEEL WELDING FITTINGS



Cataloged FOR YOUR CONVENIENCE



CATALOG S-309 gives complete specifications and list prices of Pittsburgh Piping and Equipment Company stainless steel welding fittings. These fittings, manufactured in Stainless Types Nos. 304, 316, and 347, are available in light weight, tube size, standard, and extra heavy weights, in sizes (I.P.S.) ranging from ¾" to 12". Their use makes possible fabrication of every type of stainless piping system with minimum equipment, simply by straight cutting of tubes to desired lengths, and plain butt-welding.

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Maximum Chemical Output per Day—12½ gallons with ⅜" piston; 50 gallons with ¾" piston. Capacity of Chemical Tank—10 gallons. Piston Sizes—⅜" and ¾". Overall Size—1'2" wide—3'3" long—2'1" high.

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manufactured by the Technical Process Division of Colonial Alloys Co., Ridge Ave. and Crawford Sts., Philadelphia 29, Pa. Available in 55-gal. steel drums, Prepaint was developed for production line application. It is applied at room temperature by dip, spray or brush and reacts chemically and bonds with the aluminum surfaces in from 15 to 60 seconds. Prepait is stable, non-flammable, non-toxic and can be stored without deterioration. A typical procedure for its application is as follows: (1) Re-move grease, dirt and foreign material from the work, (2) immerse the work in Prepaint solution at room temperature for from 15 to 50 seconds, rinse and dry, (3) spray, dip or otherwise apply paint or lacquer. The resultant finish is claimed to have good adhesion and uniformity.

FOR MORE INFORMATION
See Reader Service Coupon or pages 157-158

65. Surface Active Agent

SURFACE ACTIVE AGENT

NOW AVAILABLE in commercial quantities is a new wetting agent manufactured by the Alrose Chemical Co., Box 1294, Providence 1, R. I. This new material, known as Sorbit P, is a flaked alkyl aryl sulphonate wetting agent containing 75 percent active ingredients and 25 percent inorganic salts. A 1 percent solution is neutral and has a surface tension at 25 deg. C. of 34 dynes per cm. per sq. cm. It has a density of 0.3 and is white to cream in color. Sorbit P is soluble in water, yielding clear, thin, neutral solutions, colorless at 1 percent concentration or less. It is claimed to be stable in acid or alkali and shows improved surface active properties in moderate concentrations of these, as well as in neutral electrolytes. When used by itself, this wetting agent produces a copious but thin, unstable foam. In the presence of electrolyte, however, the foam is more voluminous, dense and stable. It shows no cleaning action when used alone or with neutral salts, but compounded with alkalis, Sorbit P shows satisfactory detergency and is said to be suitable as an industrial household cleaner. Its wetting properties are substantially unaffected by temperature changes. A number of applications are suggested for the textile industry, for textiles, cleaners, metals, rubber, and it may also be used as a fire extinguishing agent.

CHEMICAL ENGINEERING NEWS

Richard F. Warren, ASSISTANT EDITOR

Student Chemical Engineers Meet at Columbia

More than 200 student engineers met at Columbia University Saturday, March 22 for the 11th Annual Metropolitan Conference of Student Chapters of the American Institute of Chemical Engineers. The morning session featured a lively symposium on chemical engineering opportunities where the functional divisions of the field were ably discussed by junior chemical engineers from nearby industries. Raymond P. de Voluy of C. A. Woolsey Paint and Color Co., Inc., spoke on "Engineering Research and Development." Leo Friend, of M. W. Kellogg Co. talked on "Process Equipment Design," and Dr. Wellman of Calco Chemical Division, American Cyanamid Co., read an excellent paper on "Production of Chemicals," prepared by his colleague Walden R. Loosli. The symposium closed with a provocative discussion of "Sales and Technical Service" by Carl A. Setterstrom, of Carbide and Carbon Chemicals Corp.

A student paper contest in the afternoon provided competition among the chapters for both graduates and under-graduates. Editors of four chemical journals served as judges awarding first and second prizes, respectively, for graduate papers to E. K. McMahon, Columbia University, for "Effect of High Frequency Heating on Bacteria and Its Application in Food Processing" and to F. B. Odasz, Jr., Brooklyn Polytechnic Institute, for "Results of Service Tests as a Means of Evaluation of Motor Oils."

For the under-graduate papers top rating was given to Bernard Cohn, C.C.N.Y., for a well-rounded discussion of "Vulcanization and Compounding of Butyl Rubber." Second place went to Ralph R. Hennig, of Columbia, for his paper on "Chlorinated Waxes," and a third award went to Arnold Kneitel, Brooklyn Polytechnic Institute, for "Wood Yeasts from Waste Sulfite Liquors."

Dr. John C. Olsen, honorary chairman, served as toastmaster at the banquet in the Men's Faculty Club and introduced Prof. James M. Church, general chairman of the Conference, D. D. MacLaren, student chairman and R. V. Jelinek, chairman of arrangements, all of Columbia. Prizes were presented following brief speeches by representatives of the following sponsoring organizations: Philip S. Otten for the New York Section of AIChE, Andrew A. Melnychuk, for N. Y. Junior Chemical Engineers, and Dean A. B. Newman, vice president and S. L. Tyler, secretary of AIChE, Sidney D. Kirkpatrick, editor of *Chemical Engineering* spoke on "What the Future Holds for the Young Chemical Engineer," taking his text from P. W. Swain's "New Proverbs for Young Engineers." (pp. 98-9 of this issue).

Large Postwar Expansion Planned by Monsanto

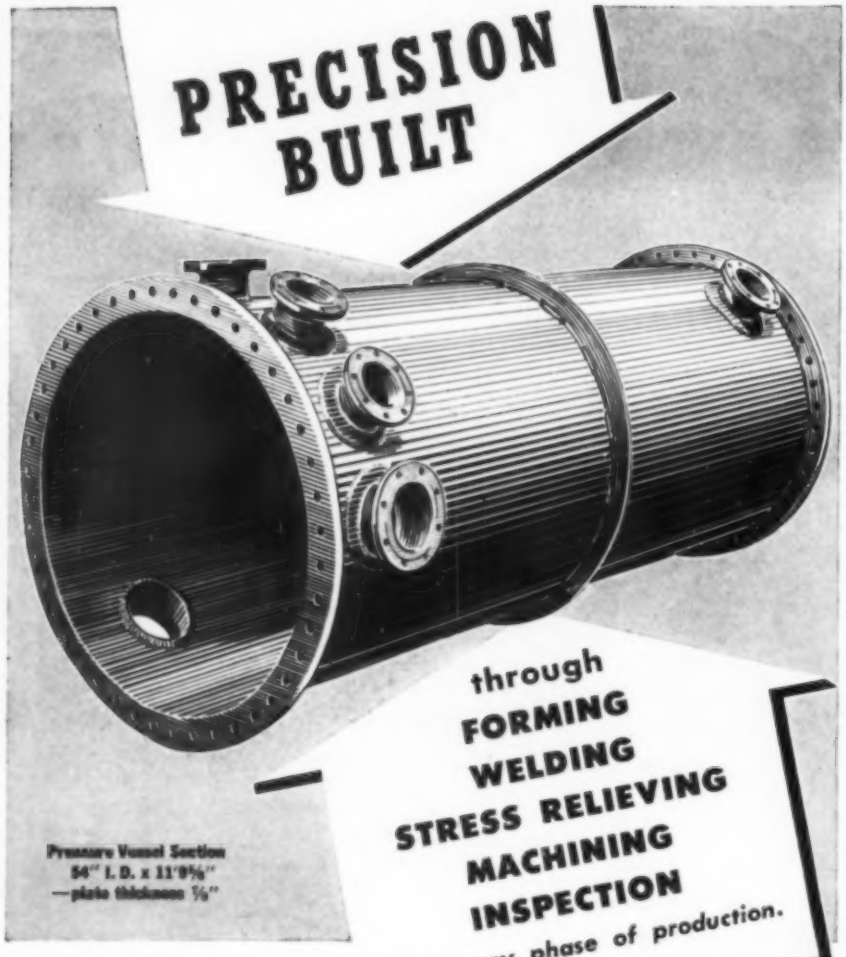
Construction involving $50,000,000 for new facilities centered on the production of new postwar products is in the engineering and planning stages and more than $22,000,000 in construction is already under way at Monsanto Chemical Co., board chairman Edgar M. Queeny reported at the annual meeting held March 25.

Speaking in the new central office building which is nearing completion at the John F. Queeny plant in St. Louis, Mo., Mr. Queeny said that the largest portion of the postwar program consists of facilities for products which are either wholly new or relatively new to the company. Only a small amount, he explained, represents additional plants for old line products except as they form raw materials for newer ones.

Study of Coal Gasification Now Under Way Near Pittsburgh

Technical groups of Pittsburgh Consolidation Coal Co. and Standard Oil Co. (New Jersey), have been exploring the possibility of applying the fluidized solids technique to coal carbonization at the Disco plant of the Pittsburgh Consolidation Coal Co. near Pittsburgh. Engineering studies and designs are under way for an additional pilot plant for the purpose of studying the complete gasification of coal. It is expected that this pilot plant, located at Library, Pa., will be ready for operation by the end of 1947. The pilot plant will consume about 50 tons of coal a day and will produce about 2,400,000 cu. ft. of gas suitable for synthesis into liquid fuels and into a gas fuel of high heat value. The coal company expects to have a com-

Drawing of the main three-story building of Carbide and Carbon Chemicals' new research center in South Charleston, W. Va. The building will house laboratories, offices, a library, and many special facilities. Grading and foundations for the main research building have begun. Engineering and construction contracts have been awarded to the H. K. Ferguson Co. of Cleveland and Ferguson personnel already are located at the site



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Precision built by National assures you of fabricated equipment that meets your most exacting and most unusual specifications. Fifty years of experience and engineering, unexcelled manufacturing facilities, modern labor saving methods and machinery—places at your service an organization capable of fabricating the most intricate industrial and processing equipment—with speed and economy.

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mercial plant for making liquid fuels and a high B.T.U. gas in operation by 1950-51.

The fluidized solids technique makes possible the production of high B.T.U. gas and liquid fuels from coal. In transforming coal or coke into gas for industrial and household use, the fluidized solids technique performs in almost the same way as it does in the big "cat" crackers of oil refineries. But instead of tossing a clay catalyst around as it does in the cracker, the fluid process this time is used to agitate the powdered coal or coke. The pow-

CONVENTION CALENDAR

American Zinc Institute, annual meeting, Hotel Statler, St. Louis, Mo., April 28-29.

Industrial Packaging Engineers Association of America, Industrial Packaging and Materials, Handling Exposition, Hotel Sherman, Chicago, Ill., April 29-May 1.

Second National Plastics Exposition, Coliseum, Chicago, Ill., May 6-10.

American Institute of Chemical Engineers, regional meeting, Coronado Hotel, St. Louis, Mo., May 11-13.

American Oil Chemists Society, 38th annual meeting, New Orleans, La., May 20-22.

American Society of Mechanical Engineers, oil and gas power 19th national conference, Cleveland, Ohio, May 21-24.

American Society for Quality Control, first annual convention and exhibit, Hotel Sherman, Chicago, Ill., June 5-6.

Chemical Market Research Association, annual business meeting, Hotel Biltmore, New York, N. Y., June 5.

University Conference on Corrosion and Metal Protection, Museum of Science and Industry, Chicago, Ill., June 11-13.

American Society for Testing Materials, annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J., June 16-20.

Instrument Society of America, second annual instrument conference and exhibit, Stevens Hotel, Chicago, Ill., September 8-12.

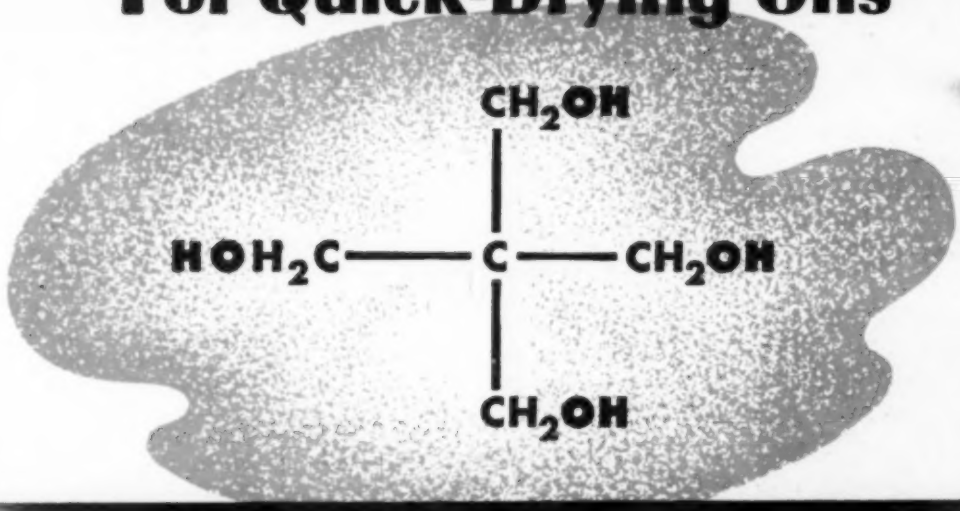
American Chemical Society, 112th national meeting, New York, September 15-19.

Electrochemical Society, fall congress, Copley-Plaza Hotel, Boston, Mass., October 15-18.

Pacific Chemical Exposition, Civic Auditorium, San Francisco, Calif., October 21-25.

Exposition of Chemical Industries, 21st exposition, Grand Central Palace, New York, N. Y., December 1-6.

For Quick-Drying Oils



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Pentek finds valuable application in coating compositions of alkyd, urea-formaldehyde, and modified phenolic resins . . . in plasticizers, emulsifying agents, and waxes . . . and as a glycerol replacement.

AVAILABILITY: 75-lb. multi-wall paper bags.

Technical literature will be sent upon request.

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dered coal, when reacted with oxygen and steam in a generator, forms a mixture of carbon monoxide and hydrogen which is called synthesis gas. Once the synthesis gas is formed and purified it can be treated by the Standard Oil Development Co.'s synthesis process where, in a reactor, using the fluidized technique with a catalyst, the synthesis gas can be converted into synthetic gasoline, diesel oil and chemicals.

The reaction in this stage of the process liberates a very large amount of heat, amounting to 1,800,000 B.T.U. for each barrel of liquid product produced. In the fluid type reactor the cooling tubes are immersed in the boiling bed of fluidized solid—an iron catalyst. The synthesis product leaving the reactor is cooled in a condenser and passed to a separator where the liquids are separated from the gases. The liquid products—high octane gasoline, diesel oil, and chemicals—undergo normal finishing treatment.

In addition to the gas and synthetic gasoline produced from coal, there are comparatively large amounts of chemicals such as ethyl alcohol, ketones, and organic acids of commercial value.

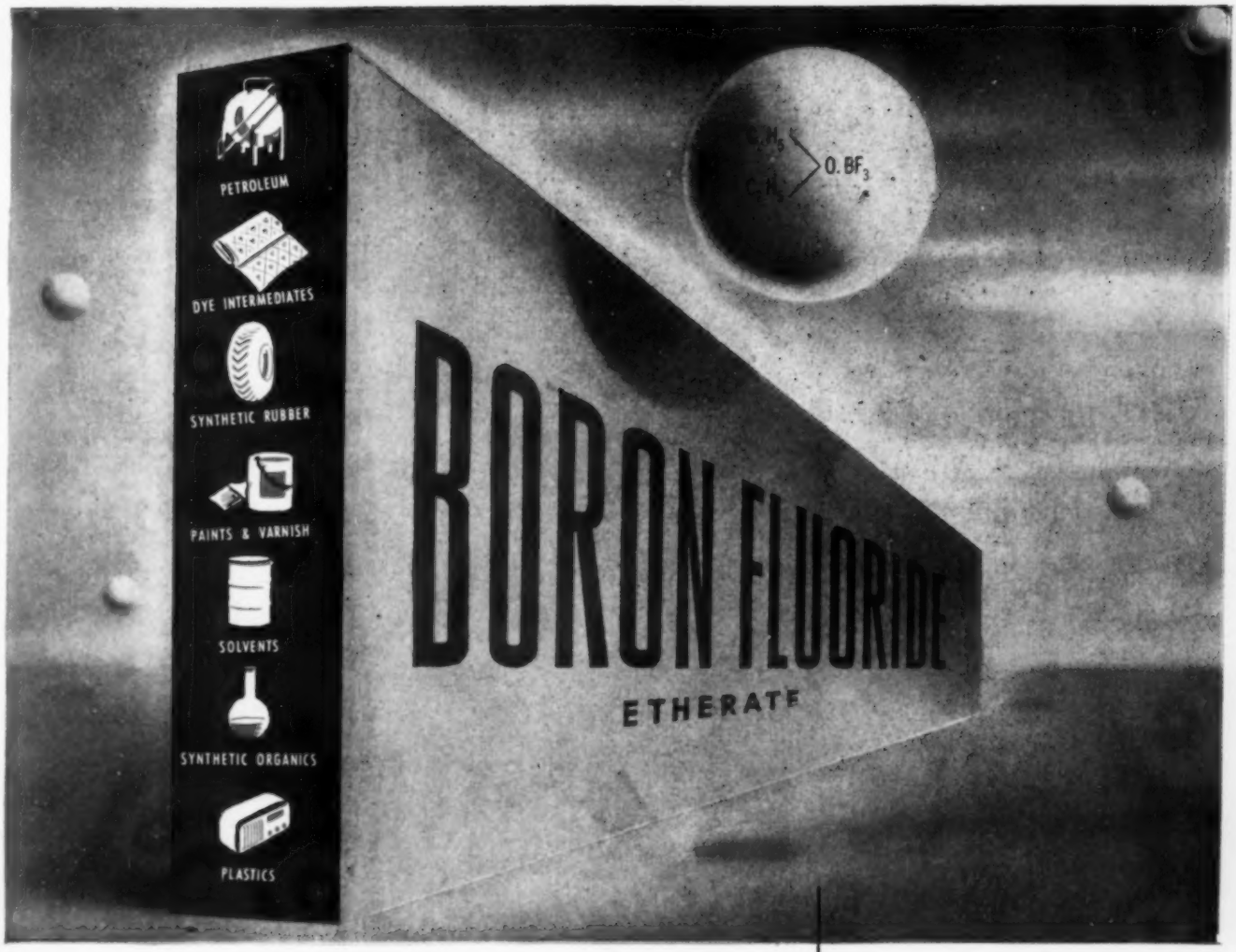
Michigan Chemical Leases Pine Bluff Arsenal Unit

THE Michigan Chemical Corp., St. Louis, Mich., has just leased a large part of the Pine Bluff Arsenal at Pine Bluff, Ark., for the manufacture of industrial and insecticidal chemicals through a newly-formed subsidiary, the Michemco Corp., Inc. The plant is advantageously located with respect of raw materials, and will thus supplement the production of the main plant at St. Louis, Mich., for increased and faster production.

According to Col. T. C. Davis, newly elected president of the Michemco Corp., the Pine Bluff plant will begin operation about May 1. Other officers of the new corporation are John L. Giles, vice president, L. W. Munchmeyer, vice president, and Clarence G. Woods, secretary-treasurer.

Western Chlorine Capacity Being Expanded

AT THE close of 1946, the chlorine-caustic soda industry of the west was operating at the rate of approximately 350 tons of chlorine daily as compared with about 180 tons in 1939. However, by early 1948 total capacity of the seven producing plants in the 11 western states is expected to approach 700 tons daily. This, which includes capacity installed, operating or under installation, will amount to approxi-



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Some of the principal reactions catalyzed by this new General Chemical Company fluorine compound are listed at the right. Others are covered in reference after reference in technical literature containing extensive data on the reactions catalyzed by BF_3 as well as by its complexes with other organic molecules. Repeatedly, mention is made of its superiority to other catalysts since reactions are moderated and fewer undesirable by-products result.

Boron Fluoride Etherate is commercially available in drums. Thus, you can investigate it for immediate application in your development or production program, confident that your needs for full scale manufacturing use can be met.

For further information, write to General Chemical Company, Fluorine Division, 40 Rector Street, New York 6, N. Y. An outline of your proposed application for this new catalyst will enable our technical staff to work with you toward a solution of your problem.

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Physical Properties

Formula:

C_2H_5 > O.BF_3 C_2H_5

Molecular Weight: 141.9
Melting Point: Less than −60°C
Boiling Point: 125°C
Specific Gravity: 1.14 at 25°C
%BF_3: 47.8% min.

Some of the Principal Reactions Catalyzed by BF_3

1. Polymerization of unsaturated compounds such as olefins, diolefins, vinyl ethers, fatty oils, and terpenes. The products may be solid polymers useful as plastics or liquids as in the bodying of drying oils for paints and varnishes.

2. Condensation of aromatic nuclei with olefins and diolefins, paraffins and olefins, and aromatic nuclei or olefins with acids.

3. As a cyclizing agent for rubber.

4. As an esterification catalyst.

5. As a catalyst in the synthesis of aliphatic acids from alcohols and carbon monoxide.

6. As a promoter and dehydrating agent in the sulfonation and nitration of aromatic compounds.

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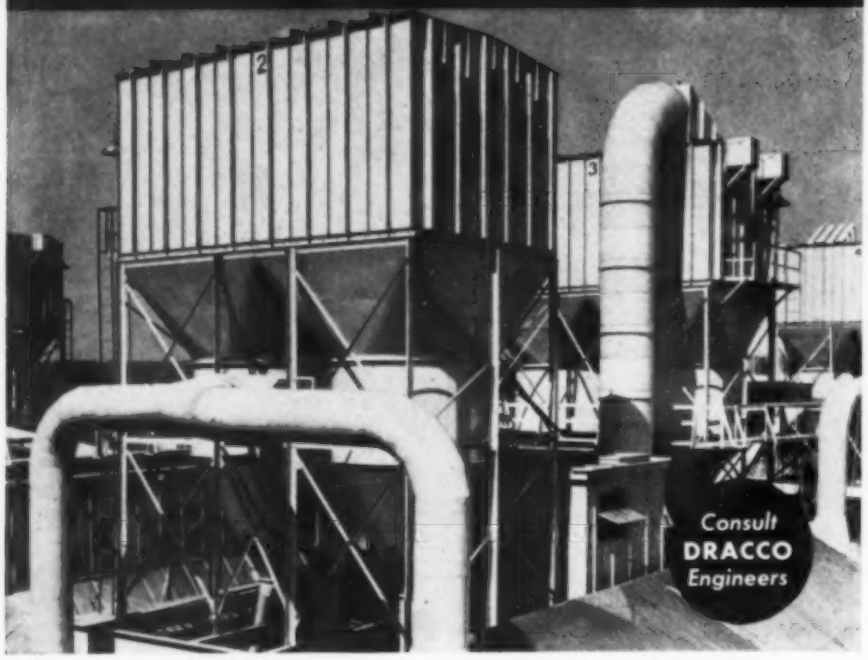

Dust will always cause wear on machinery and equipment, that results in higher maintenance cost. In many ways dust slows production and reduces the overall efficiency of any plant. Even in small quantities dust is a hazard that should be eliminated. DRACCO Dust Control ALWAYS saves money, and where recovery of valuables is a factor, there are EXTRA SAVINGS. Why not discuss your dust problems with DRACCO Engineers? Their recommendations, based on over thirty years of experience in dust and fume control, may lead to considerable savings in your plant.

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DUST CONTROL EQUIPMENT
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mately 14 percent of the 5,000-ton total projected capacity of the United States. Present capacity of the nation is about 4,100 tons daily.

Among the new western plants in production, one of the largest is that operated by Stauffer Chemical Co. at Henderson, Nev. The Chemical Warfare Service plant at Rocky Mountain Arsenal, near Denver, soon will be operated under a 15-year lease by Colorado Fuel & Iron Corp. This unit, with a total design capacity of 100 tons of chlorine daily, has a liquefying capacity of 20 tons. The new plant of Pennsylvania Salt Mfg. Co. of Washington at Portland, now over 75 percent completed, is expected to begin operations by mid-summer. Meanwhile, expansion in several other present units are already underway. One small producer in Los Angeles has ceased production of chlorine.

ACCL to Hold Semi-Annual Meeting in Los Angeles

THE Western Division of the American Council of Commercial Laboratories will be host to the Council at its semi-annual meeting to be held at the Hotel Ambassador, Los Angeles, on May 26 and 27. Roger W. Truesdail, of Truesdail Laboratories, Inc., Los Angeles, who is president of the Western Division of the Council will welcome the members.

One of the important matters to be discussed at the May meeting, is the more extensive use of commercial testing laboratories by government departments, as it is felt much of this type of testing can be competently handled by commercial laboratories with consequent savings to the American taxpayer.

Short Course in Statistical Quality Control

AN ADVANCED eight-day course in Quality Control by Statistical Methods is to be presented June 27 through July 5 at Purdue university, Lafayette, Ind. It is intended for those who already have some acquaintance with statistical quality control from such a course as the War Production Board organized during the war.

The course will be under the leadership of I. W. Burr of Purdue University. The other instructors in the course will be Edwin G. Olds of Carnegie Institute of Technology, Lloyd A. Knowler, University of Iowa, and Mason E. Westcott, Northwestern University.

All subject matter in the course will be simplified as much as possible. Topics will include: background of control charts, significance of differ-

KOPPERS fire-retardant **TREATMENT**

GIVES plus protection

TO THIS ROOF

Although it's not apparent to the eye, something important has been added to this roof. A special Koppers pressure-treatment has promoted the wood into the *fire-retardant* class. Sparks find discouragement, instead of a welcome.

One early installation got a dramatic test when a fire broke out in a lacquer pit and roared like a blow-torch up against the roof structure. There was no spreading of the fire, so the efforts of the fighter-crew were concentrated on the pit itself. When the fire was out, in spite of heat that had ruined electrical conduit and fixtures, the only damage to the wood was a char in the area exposed to flame. Even this was so shallow that structural integrity of the beams was not impaired—no replacements were made.

Fire-retardance adds another to the long list of economies and advantages that recommend pressure-treated wood for many varieties of structures: low first cost, low maintenance, ease and speed of construction, ease and economy of alteration, enduring resistance to decay and insect attack. Koppers treating plants, located in strategic areas, are equipped to pressure-treat your lumber . . . and, if desired, to frame it to blue-print prior to treatment. For helpful information on treatments and applications, ask for our bulletin, "Economical and Permanent Construction with Pressure-Treated Wood."

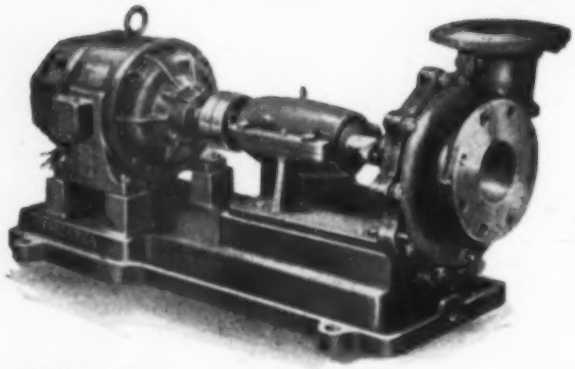
K KOPPERS

PRESSURE-TREATED WOOD

KOPPERS COMPANY, INC.

PITTSBURGH 19, PENNSYLVANIA

CENTRIFUGAL PUMPS "Custom-built" for peak efficiency



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TENN. EASTMAN CORP.
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U. S. CHEMICAL WARFARE SERVICE

Prompt Delivery

Chemical Plants have specified this typical special single-suction pump for handling chemicals.

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EAST 7th ST., FREDERICK, MARYLAND
Over a half century of supplying outstanding industries with outstanding products

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Use Yarway Nozzles. No internal vanes or other restrictions to clog or hinder flow. Two types—Yarway Involute-type producing a fine hollow spray with minimum energy loss, and Yarway Fan-type producing a flat fan-shaped spray with time-saving slicing action for cleaning.

Wide range of standard sizes and capacities. Cast or machined from solid bar stock.

Thousands in use. Write for new Bulletin N-616.

YARWAY SPRAY NOZZLES

FAN-TYPE FOR FLAT SLICING SPRAY

YARNALL-WARING COMPANY
137 Mermaid Avenue, Philadelphia 18, Pa.

ences, analysis of variance, linear and multiple correlation, sequential analysis and other sampling, and use of calculating machines. The presentation of the characteristics and applications of these statistical tools will be helpful to many of those who are now using statistical quality control.

Full-Time Editor For Southwest

To MEET the rapid development of the chemical process industries in the Southwest, *Chemical Engineering* early in April transferred J. V. Hightower from its Washington, D. C., office to Houston, Tex., where he will serve as Southwest Editor. He is making headquarters at McGraw-Hill News Bureau offices, Merchants & Manufactures Bldg. Mr. Hightower is

J. V. Hightower

a native Texan and a chemical engineering graduate of the University of Texas. His experience includes service with the Petroleum Administration for War, M. W. Kellogg, Humble Oil, Magnolia Petroleum, and Gulf Publishing Co.

The Gulf Coast has 21 percent of the war plants built—some $322,014,000 worth. Postwar plans call for new plants totalling in cost $300,576,000 or 34.2 percent of new process plants in the country.

Monsanto Plans Commercial Polyvinyl Chloride Output

THE Board of Directors of Monsanto Chemical Co. has announced approval of a company project which would launch Monsanto into the commercial production of polyvinyl chloride plastic on a major scale. The project, which follows more than three years of extensive pilot plant production, involves construction of manufacturing facilities at the company's plastics division, Springfield, Mass. The decision to produce polyvinyl

with 2 forms

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can simplify your STAINLESS problems

SOLID STAINLESS STEEL

STAINLESS-CLAD STEEL*
(10% to 50% cladding)

Pressure vessel fabricated entirely from JESSOP Type 347 Stainless Steel by National Annealing Box Company, Washington, Pa.

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JESSOP Stainless-Clad Steel is available in sheets and plates; also, flanged and dished heads. JESSOP Solid Stainless Steel is available in sheets, plates, bars, forgings, castings, and special and formed shapes.

JESSOP manufactures Stainless in both solid and composite form in a wide variety of sizes and conditions. Where your requirements call for both of these products, you will find that selection and deliveries are facilitated by dealing with one organization.

For further information, contact your nearest JESSOP representative . . . or write direct.

*U.S. Pat. Nos. 1,997,538; 2,044,742; 2,147,407; 2,225,862. Can. Pat. No. 383,153.

JESSOP STEEL COMPANY

WASHINGTON, PENNSYLVANIA

Tailor-made Specialty Steels

Corrosion-Proof Rolls and Processing Tanks

Knight-Ware corrosion-proof wire and sheet rolls or sinkers are made to meet customers' needs. You can choose the diameter, groove spacing and length to fit your operation. They are entirely acid-proof and hard with no coating or shell to depend on for acid resistance or wear.

Pickling and plating tanks which are acid-, alkali- and leak-proof are available of Pyroflex Construction. These are steel tanks lined with suitable corrosion-proof materials to best meet your particular operating conditions.

Knight engineers welcome your inquiries on wire rolls and Pyroflex processing tanks. Be sure to give them as complete data as possible regarding the character and purpose for which this equipment is to be used.

MAURICE A. KNIGHT
104 Kelly Ave., Akron 9, Ohio

Typical Knight Pickling Tank of Pyroflex Construction

chloride plastics places Monsanto in a position to supply a complete line of plastics for all major uses.

Monsanto said it will produce Polvin in the form of elastic films and sheets; as colored and transparent rigid sheets; as extrusion compounds, molding compounds, calender compounds and polyvinyl chloride base resins.

Oil Chemists Annual Meeting Coming in May

THE technical program for the 38th annual meeting of the American Oil Chemists' Society to be held at the Hotel Roosevelt, New Orleans, La., on May 20-22, will include two symposiums, one on analytical methods and the other on industrial products from oilseed meals and proteins. A. M. Altschul of the Southern Regional Research Laboratory, New Orleans, is program chairman.

Election of officers will take place at the annual meeting on May 22, at which the presiding officer will be the president, S. O. Sorensen, of the Archer-Daniels-Midland Co., Minneapolis. Chairman of the nominating and election committee is R. R. King of the Interstate Cotton Oil Refining Co., Sherman, Tex. General convention chairman, also hotel chairman, is Col. H. P. Newton of the Southern Regional Research Laboratory.

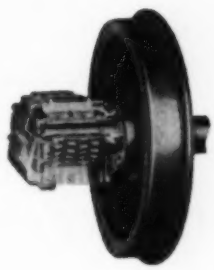
New Soda Ash Producer Operates on Owens Lake

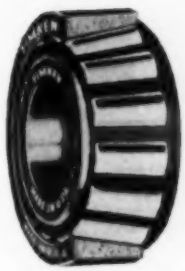
OPERATIONS at the new soda ash plant of Permanente Metals Corp. at Owens Lake, Calif., are well under way and the unit is now supplying critical ash to the firm's alumina plant at Baton Rouge, La. The plant has a design capacity of approximately 100 tons daily. Because of the nation-wide shortage of this chemical, the new facilities were rushed to completion in 67 ten-hour working shifts. Continuous operation of Kaiser aluminum plants is further assured by completion of the Owens Lake project, since Permanente plans to establish a fully integrated aluminum industry, complete from mining of bauxite in South America to rolling operations in Spokane.

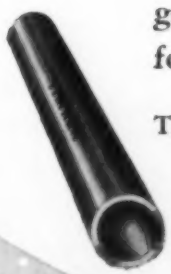
Brine is pumped from wells sunk about eight feet in the crystal bed of the shallow lake. A 3.5-mile pipeline brings the brine to one of two 500,000-gal. storage tanks from where it is pumped through three vertical shell-and-tube heat exchangers and heated to approximately 100 deg. F. The heated brine enters the top of the 94-ft. carbonating towers, of which there are four each with a capacity of

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.







Means "Made By The Timken Roller Bearing Company." It identifies the source of Timken Tapered Roller Bearings, Timken Railroad Roller Bearings, Timken Alloy Steel, Timken Seamless Steel Tubing and Timken Rock Bits. This trade-mark is your assurance of getting genuine Timken products. Look for it when buying.

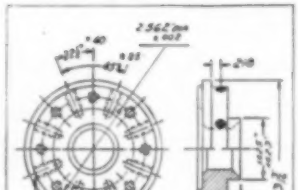
THE TIMKEN ROLLER BEARING COMPANY
CANTON 6, OHIO

Precision Adapter for Drill Presses Perfects Alignment—Prevents Drift!

The New Aetna Adapter, of aluminum alloy, fits the columns of most small drill presses—assures accurate milling and deep hole drilling—without a drill jig. It firmly and accurately holds interchangeable drill bushings close to work.

Precision alignment is accomplished through an eccentric aligning bushing, which once set needs no further adjustment. Filler bushings cover the entire bushing range up to ½". Stops to locate the piece to be drilled, are attached to the press table or directly to the adapter. Milling chatter is avoided. Chip interference is eliminated. Overlapping holes can be drilled without punch marks, or indication of run-out, with drills as small as 1/32" diameter. ¼" holes can be drilled more than 6" deep with as little as .006" drift.

Accuracy in work is achieved best by alert workers. That's why many plant owners make chewing gum available to all. The chewing action helps relieve monotony—helps keep workers alert, aiding them to do a better job with more ease and safety. And they can chew Wrigley's Spearmint Gum right on the job—even when hands are busy.



Example of piece drilled with Aetna Adapter

You can get complete information from
Aetna Mfg. Co.,
250 Chicago Ave., Oak Park, Ill.

AB-61

20,000 gal. Four 110-hp. oil-fired boilers produce steam to drive three compressors. Exhaust steam serves to heat the brine before it enters the carbonators.

Carbon dioxide from the boiler stack gases is cleaned and cooled in two gas scrubbers, after which it is compressed and pumped into the bottom of the carbonating towers. Here the CO_2 produces either sesquicarbonate or bicarbonate, the slurry of which is fed by gravity flow to the first of a series of five counterflow thickener tanks, each 40 ft. in diameter. The concentrated slurry then goes to four 48-in. centrifuges. The cake is moved by conveyor belt a short distance to the two rotary kilns, approximately 80 ft. long by 7 ft. in diameter, where it is calcined at a temperature up to 600 deg. F. The granular soda ash is then cooled and stored.

Calco Constructs New Plant Units at Willow Island

VAST plant construction program of the Calco Chemical Division, American Cyanamid Co., is rapidly taking shape at Willow Island, W. Va., 17 miles north of Parkersburg. The company states that production of pharmaceuticals, melamine and inorganic pigments will be centered at the new Willow Island Works.

Paint and Varnish Facilities Expanded at Houston

AN EXPANSION program to cost $500,000 at the Pittsburgh Plate Glass Co.'s Houston, Tex., paint and varnish plant has been announced. Preliminary construction work will begin immediately. Production capacity for the manufacture of paints and varnishes will be double the capacity of the original plant, construction of which was begun in the summer of 1940. Another paint and varnish plant under construction at Springdale, Pa., will soon be in partial production.

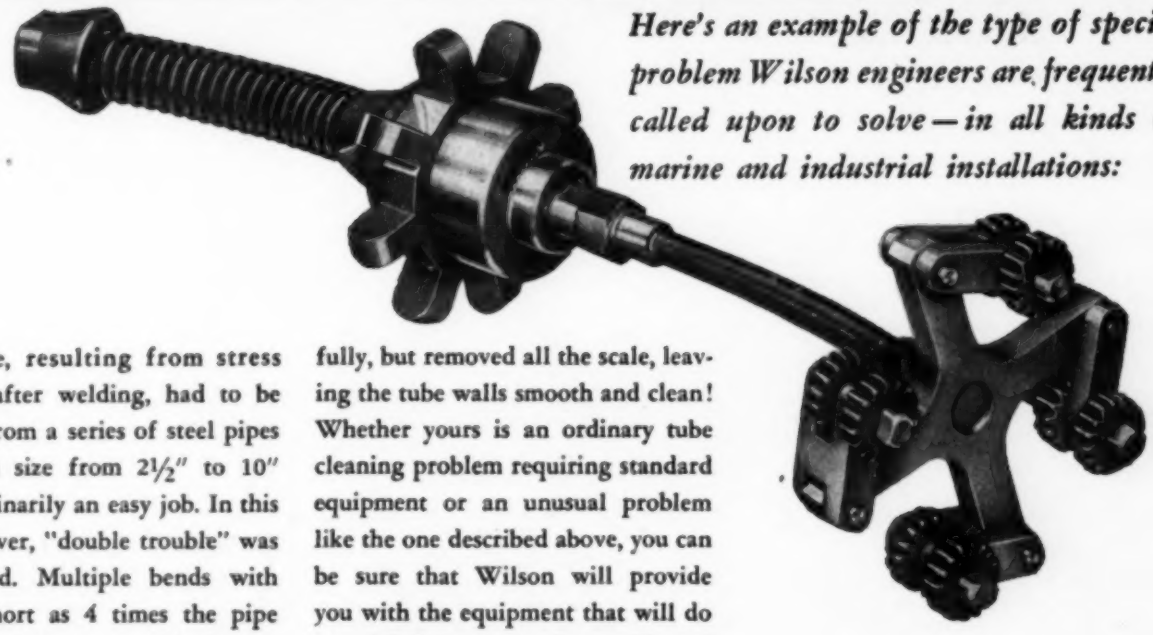
Winthrop Opens New Dustless Plant

A NEW windowless, dustproof plant designed to be run under constant scientific control for the preparation of injectable medicines in ampules has been opened by the Winthrop Chemical Co., Inc., at Rensselaer, N. Y. The plant has a unique system of dedusting personnel. Before entering the main building where the products are made, all employees and visitors must walk through one of two narrow passageways lined with double dedusting blowing and suction units designed

DOUBLE TROUBLE

in this piping installation

CLEARED UP WITH A WILSON CLEANER



Here's an example of the type of special problem Wilson engineers are frequently called upon to solve—in all kinds of marine and industrial installations:

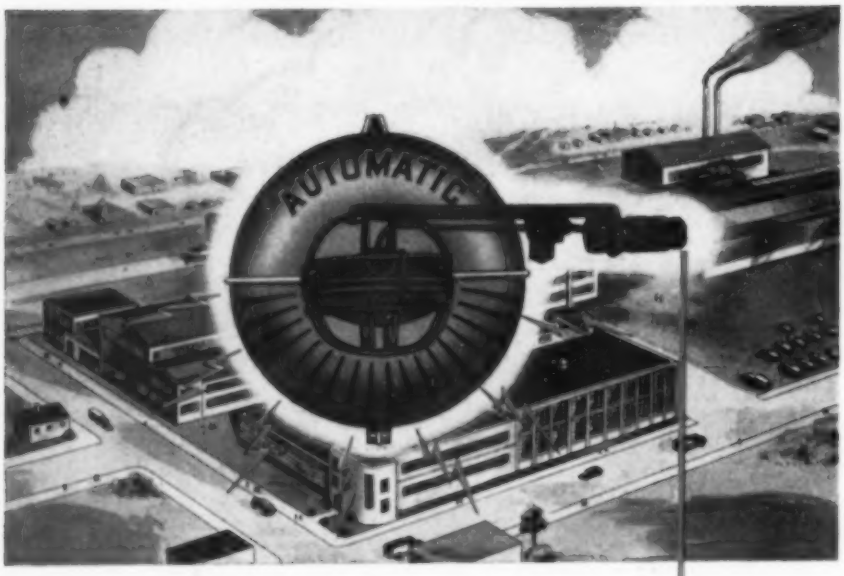
Mill scale, resulting from stress relieving after welding, had to be removed from a series of steel pipes varying in size from 2½" to 10" O.D.—ordinarily an easy job. In this case, however, "double trouble" was encountered. Multiple bends with radii as short as 4 times the pipe diameter had to be negotiated—and all possibility of marring the interior tube surface had to be eliminated. Specially engineered Wilson Tube Cleaning Equipment made quick work of this problem. It not only negotiated the short bends successfully, but removed all the scale, leaving the tube walls smooth and clean! Whether yours is an ordinary tube cleaning problem requiring standard equipment or an unusual problem like the one described above, you can be sure that Wilson will provide you with the equipment that will do *your* job faster, more thoroughly and more economically. Why not send for the name of your local Wilson representative? He is always ready to help you find the way to greater operating economy through more efficient tube cleaning.

THOMAS C. WILSON, INC. • 21-11 44th Ave., Long Island City 1, N. Y.

WILSON

TUBE CLEANERS

TW—726



When Fire Strikes—

it's seconds that count..

And seconds may well spell the difference between excessive loss — or — little or no loss at all. For when fire threatens, the sounding of an early alarm is imperative. That's where the unlimited fire protection advantages of the Suprotex Sprinkler System are shown. It detects fire by means of the rate of temperature rise rather than by a predetermined degree which temperature reaches. Feature . . . an early alarm, long before fire sufficient to fuse sprinklers develops.

Suprotex is not new in fire protection development. Thousands of these systems are daily standing guard over many millions of dollars in property valuations, and their speed of fire detection plus dependability of operation under all types of conditions are past proved.

Would you be interested in seeing a demonstration of the Suprotex Sprinkler System? "Automatic" Sprinkler's fire protection engineers are equipped to show you . . . right in your own office and without inconvenience to your office arrangement or routine. Write or call "Automatic" Sprinkler Corporation of America, Youngstown 1, Ohio.

THE SUPROTEX® SPRINKLER SYSTEM

—a famous member of the "Automatic Sprinkler Family. Designed particularly for use in manufacturing, mercantiles, warehouses, schools, churches, offices, hospitals, piers and other establishments where positive fire protection is essential.

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FIRE PROTECTION

DEVELOPMENT ENGINEERING

"Automatic" Sprinkler

MANUFACTURE INSTALLATION

"AUTOMATIC" SPRINKLER CORPORATION OF AMERICA

YOUNGSTOWN 1, OHIO

OFFICES IN PRINCIPAL CITIES OF NORTH and SOUTH AMERICA

"Automatic" Sprinkler devices and systems are listed by Underwriters' Laboratories, Inc., and approved by Factory Mutual Laboratories.

to remove lint and dust from their clothing. The building is completely air conditioned and is zoned so the individual rooms may have different climates. Fresh air is passed through filters, Precipitrons and over germicidical lamps before it enters the conditioning system.

Mathieson Expansion Program To be Completed This Year

TOTAL cost of the present plant modernization and expansion program of the Mathieson Alkali Works is now estimated at $9,500,000. This estimate does not include alteration of the recently acquired government ammonia plant at Lake Charles. The program which was started in 1945 will probably be completed in late 1947. Production of caustic soda and soda ash will be substantially increased.

Modernization and replacement were made necessary by the wear and tear of wartime production schedules and the increase in capacity was dictated by the growing demand of essential industries for the chemical products.

Outlet for the increase in caustic soda production at Saltville is assured by the increasing demands of nearby rayon plants and other users now very short of this essential chemical. At Lake Charles, soda ash production will be increased. The demand for light ash in southern aluminum plants built during the war and the continuing shortage of this product in other industrial markets provide an outlet for capacity production. An undetermined percentage of the soda ash output will be made into dense ash to supply the growing glass industry of the southwest.

Oxygen-Anthracite Gas Produced Successfully

SATISFACTORY results were obtained at Trail, British Columbia, in manufacture of synthesis gas from fine sizes of anthracite with oxygen blast in Wellman-Galusha producers by plant-scale trials made at Consolidated Mining and Smelting Co. of Canada. This work was directed by Dr. C. C. Wright of Penn State College, who reports in a preliminary way very satisfactory results through the Anthracite Institute.

Carload lots of barley and rice sizes of anthracite were gasified in these tests for production of a high-purity synthesis gas containing CO and H_2 in desirable ratios. The purity compared favorably with comparable gas made commercially from coke. The producer when blown with steam and oxygen gasified rice anthracite at double and barley anthracite at triple

"there goes another one, Dad!"

Yes, you see them everywhere! Mathieson's tank cars really get around as they speed millions of gallons of dependable Mathieson chemicals to our hundreds of customers throughout the chemical-consuming industries.

Mathieson transportation equipment also includes super-insulated Mathieson Dry Ice cars . . . multi-unit Chlorine Gas tank cars holding 15 one-ton containers (a method of delivery originated by Mathieson) . . . drums, barrels, containers . . . Ammonia, Chlorine and Carbonic Gas cylinders.

Modern transportation equipment helps maintain Mathieson's reputation for making prompt deliveries of the best in chemicals. *The Mathieson Alkali Works (Inc.), 60 East 42nd Street, New York 17, N. Y.*

Mathieson
CHEMICALS

Caustic Soda . . . Soda Ash . . . Bicarbonate of Soda
Liquid Chlorine . . . Chlorine Dioxide . . . Ammonia, Anhydrous & Aqua . . . HTH Products . . . Fused Alkali Products . . . Synthetic Salt Cake . . . Dry Ice . . . Carbonic Gas . . . Sodium Chlorite Products . . . Sodium Methylate

Trentweld

for everything you want in STAINLESS TUBING

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Corrosive applications
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High pressure service
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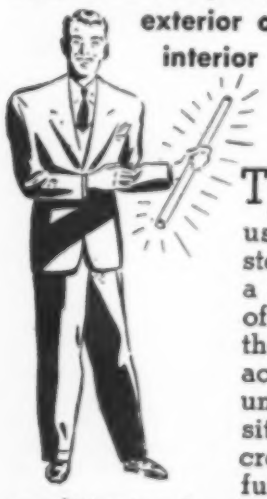
High temperature installations

Any size from 1/8" to 30" diameters in lengths up to 24 feet

Finished to any degree exterior or interior



Precision production held to micrometer tolerances

TRENTWELD advantages are all inclusive, important to every user of austenitic stainless steel tubing. They are based on a singular automatic method of rolling and fusion welding that produces improved characteristics in the metal—an unusual uniformity in composition and structure. This increased capacity for service is further fortified by special conditioning for chemical use in precisely controlled annealing and pickling operations. Carbon content can be held as low as 0.02–0.03%.

Call on Trentweld engineers for help in determining the best alloy among stainless steels or Inconel to meet the need of your particular problem. Without obligation, address Dept. 10 on applications you have in mind, or write for the Trentweld Data Bulletin.

TRENTWELD STAINLESS STEEL TUBES

Sales Office—664 N. Michigan Avenue
Chicago 11, Illinois

TRENT TUBE MFG. CO.

Mill at
East Troy, Wisconsin

the production rates of the same equipment gasifying with air and steam. Further development of the engineering possibilities here suggested is contemplated by the anthracite industry.

Plastics Are Slowed by Materials Shortage

PLASTIC production this year is slowed more by shortage of materials than by any other single factor. Reporting on the situation to Society of Plastics Industry, Frank Carman of P.M.M.A. described current troubles as follows:

Thermoplastic molding material generally meets needs, but thermosetting materials are still short, despite record production.

A few months delay in recent plant construction in many parts of the industry has been less serious than the shortage of phenol, formaldehyde, urea, and phthalic anhydride.

Further plant expansions will be futile in increasing supply unless provision is made for basic chemicals also.

Vinyl resins are still far short of requirements, despite large capacity increases, some of which will not come into operation until near the end of 1947. However, use of vinyl resins is still seriously handicapped by scarcity of proper plasticizers.

Plastics users can safely lay plans years ahead, so far as plastic materials producers are concerned. But the materials shortages indicated above may delay full use of plastics for perhaps a year, despite production in excess of estimates made a year ago.

Powdered Iron Produced by Electrolytic Process

USING a new electrolytic process which is said to give a product purer than that made by other methods and at a competitive manufacturing cost, Tacoma Powdered Metals Co., Inc., began production in February of powdered iron in a unit at Tacoma, Wash. While the immediate goal of the plant is 10 tons of product daily, there is room for future expansion in the present set-up.

The process uses steel borings and turnings, hydrochloric acid and hydrogen, all of which are in adequate supply in the Northwest. Steel turnings are dumped into an inclined battery of open, concrete vats through which flows a solution of ferric chloride from the cells. The resulting ferrous chloride solution is clarified and passed through a second leach to remove all ferric chloride and excess hydrochloric acid. It is then pumped into the bottom of the rectangular cells, of which there are 40. Graphitized carbon

For Your Fine Chemical Needs

B&A MERCURIC NITRATE

Reagent

Made to Baker & Adamson's own strict Reagent specifications, this white crystalline product assays 99% min. $Hg(NO_3)_2 \cdot H_2O$. Low in iron and chloride, it offers a purity suitable for many exacting uses such as the preparation of mercuric nitrate ointments for treating skin disorders. Other applications for this material include: carroting of furs for felting into hats; manufacture of mercury fulminate used in percussion caps and detonators; ingredient of baths for producing blue-black or gray-black colors on iron and steel; manufacture of organic mercurials used for closed-system papermaking plants, for protecting soil, seeds, and wood against certain fungi and insects, and for prevention of mold formation in paints and varnishes; preparation of mercuric acetate, etc.

Rely on General Chemical's

B&A BARIUM FLUORIDE

Reagent & Technical

A superior product, low in impurities, this B&A Quality chemical assays 99% min. BaF_2 in the Reagent grade and 98% min. in the Technical. Thus, Industry has two forms of exceptionally high purity to consider for the many applications of this product. Some of these include: flux in preparation of high-copper alloys; flux or opacifier in manufacture of enamels, glass and ceramics; manufacture of heat-treating salts; as an insecticide; as an agent for insulating electrodes used in electronic cathode ray tubes; in the manufacture of arc lamp electrodes, etc.

Baker & Adamson Division

B&A ACETYL CHLORIDE

Reagent & Technical

Both grades of this B&A purity product have the same high assay of 95% min. CH_3COCl. Many users requiring quality acetyl chloride in quantity find the Technical grade meets their needs. Among the applications for this B&A Fine Chemical are: an intermediate in the manufacture of organic pharmaceuticals, i.e. heroin (diacetylmorphine); acetylating agent in the synthesis of organic chemicals such as acetophenone, acetoresorcinol, and acetamide; manufacture of acetyl peroxide.

★

This is the fourth in a series of advertisements reviewing the B&A Fine Chemicals *commercially available* to American Industry today from the Baker & Adamson Division of General Chemical Company. Scores of such purity products await your investigation. To learn more about these or other B&A Fine Chemicals that meet your requirements, write or phone nearest B&A Sales and Technical Service Office.

GENERAL CHEMICAL COMPANY

BAKER & ADAMSON DIVISION

40 RECTOR STREET, NEW YORK 6, N. Y.

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SETTING THE PACE IN CHEMICAL PURITY SINCE 1882

*Complete stocks carried here.

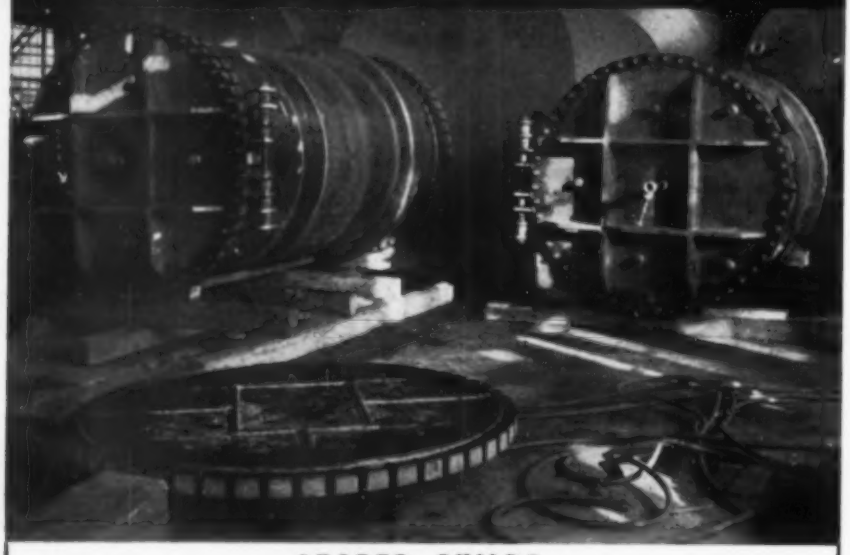
FINE CHEMICALS

B&A

STANDARD OF PURITY

FOR AMERICAN INDUSTRY

MONEL HEATER



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2200 N. JASPER DECATUR, ILLINOIS

IMMEDIATE DELIVERY

on New DO-ALL Ribbon Mixers and Blenders

These new spiral type machines are available for wet or dry mixing. Of rugged welded steel construction, they are built for hard service. Come in 25 to 2,000 lb. sizes, standard or heavy duty. Send NOW for full information.

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anodes and stainless steel cathode sheets are used. Current at 365 volts and 5,000 amp. is supplied by rectifiers. Depending upon conditions desired, the current density varies from 40-60 amp. per sq.ft. A high hydrogen over-voltage is maintained.

High-purity iron is deposited on the stainless steel cathode and is removed by an automatic stripper invented by Jacob Schoder, vice president and plant manager, which lifts the cathode plates from the bath, strips off the deposited iron, buffs the plates and then returns them to the bath. Meanwhile, the spent electrolyte overflows the top weirs of the cells, maintaining a constant level, and after the introduction of a small amount of make-up hydrochloric acid, returns to the scrap iron leaching system to be converted from ferrous to ferric chloride.

The iron is next washed and dried, then ground to a powder of desired mesh in a ball mill. The powdered iron passes through a hydrogen reduction furnace which removes any combined oxygen. It is then ready for packing in containers for shipment. At present, the firm is shipping its product to Detroit, Cleveland, Cincinnati and Chicago.

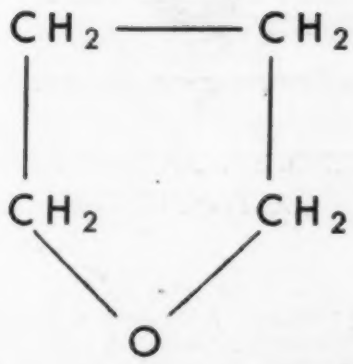
Fiberglas to Build Unit On West Coast

PURCHASE of a 42-acre plant site in Santa Clara, Calif., about 40 miles south of San Francisco, has been revealed by Owens-Corning Fiberglas Corp. as a preliminary step in the erection of a western factory. The plant has been estimated to cost close to $7,000,000 and will produce insulation for buildings, low-temperature purposes and for refrigerators, ranges and water heaters. Eventually, units will be installed to produce roofing mat products, Fiberglas pipe wrap, used in protecting underground lines against corrosion, and for newly-developed glass fibers to be used in clothing interliners, aircraft acoustical blankets and filling for pillows and mattresses. Production is scheduled to begin late in 1948 and the eventual employment of 1,000 persons is anticipated.

Correction:

"Estimating Chemical Piping Costs," pp. 109-110 *Chemical Engineering*, January 1947, should have been attributed to J. W. Strohecker and R. J. Schrader, Tennesee Eastman Corp., Oak Ridge, Tenn., instead of to R. J. Schrader alone. Dr. Strohecker was responsible for much of the work of developing the formula for estimating piping labor requirements.

CELANESE ANNOUNCES TETRAHYDROFURANE



Tetrahydrofurane, in pilot plant quantities, is now being produced by Celanese Corporation of America. This active solvent and intermediate is scheduled for quantity production in the very near future. As a solvent for vinyls, tetrahydrofurane has outstanding properties. It can be used as a solvent and intermediate—for making adipic acid, succinic acid, related anhydrides, and other important chemicals.

PHYSICAL PROPERTIES

COLOR		water white
SPECIFIC GRAVITY	20°/4° C	0.888
FLASH POINT	open cup	Below 70° F.
BOILING POINT	°C	66°
REFRACTIVE INDEX	$n_{20}D$	1.4070

Pilot plant development with tetrahydrofurane can be carried out with the assurance that commercial quantities for your requirements will be ready when you need them. Address your requests for sample to: *Celanese Chemical Corporation,* division of Celanese Corporation of America, 180 Madison Avenue, New York 16, N.Y.

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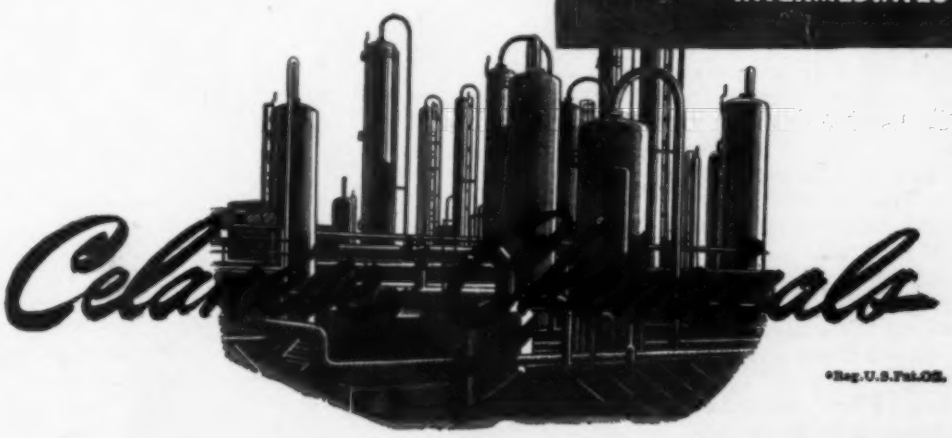
ORGANIC PHOSPHATES
PLASTICIZERS
INTERMEDIATES



Celanese Chemicals

*Reg. U.S. Pat. Off.

NEWS FROM ABROAD

Special Correspondence

PETROLEUM INTERESTS IN GREAT BRITAIN PLAN LARGE EXPANSIONS IN THE FIELD OF CHEMICALS

Special Correspondence

WHILE THE acute phase of the fuel crisis has passed, the horizon of British industry remains dark. Coal stocks are still dangerously low, and if public utility restocking for next winter is treated as a first charge, industrial fuel consumption during the summer must inevitably suffer. The government has gone back to the allocation system with which an abortive beginning was made in January, but with the difference that ordinary industrial consumers will get one-third only (not one-half) of their normal requirements. To this basic allocation come extra supplies for important trades which are left to the discretion of the regional controllers. As, however, the total coal supply left over for current use in industry (apart from public utilities) covers no more than two-thirds of the estimated requirements, even industries of recognized importance, like the chemical trades, face the prospect of permanent under-supply of coal—unless there is an average coal output increase of about 10 percent in the next six months, and no industrialist would care to rely on that.

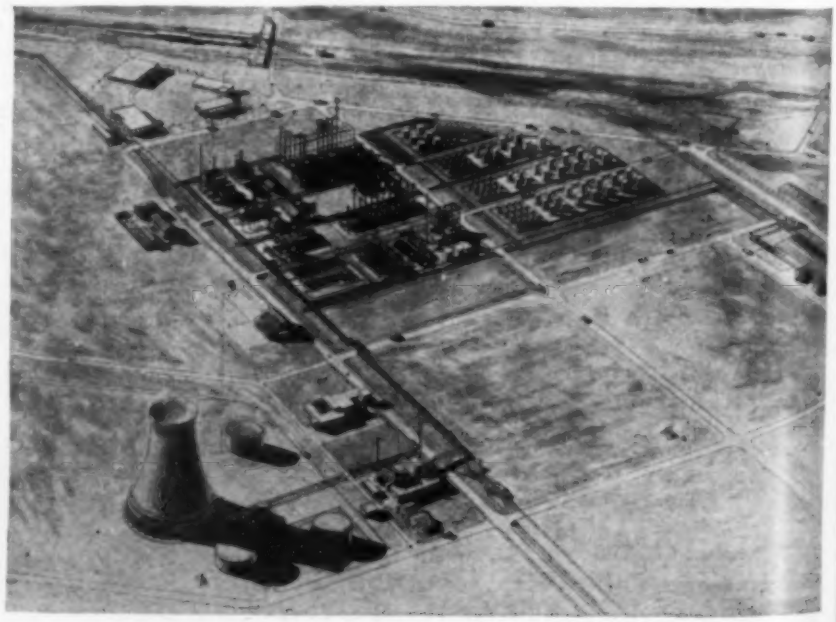
The suspension of the ban on industrial electricity consumption in theory enables chemical manufacturers to go back to "normal" operations. Unfortunately the severe weather has prevented any general replenishment of coal stocks. In some outlying districts chemical factories rely on 'open-cast coal brought up by road. In most of the chief industrial regions arrivals of coal by rail continue irregular, and public supply undertakings get first priority. In these circumstances many chemical works are still operating below capacity. The pressure of demand, on the other hand, does not slacken. Consumption of chemicals has certainly been slowed down by the power cut, fuel shortage and transport delays, but buyers snatch up any small parcel they can obtain because it is widely thought that supply difficulties will continue for some time. Prices still tend upwards and this adds to the demand.

Several of the firms which announced expansion schemes during last year are faced with obstacles in obtaining the necessary equipment. Delivery periods of up to three years are specified by plant makers for orders received now, and the fulfillment of earlier contracts for new apparatus and machinery has been delayed, in some instances by substantial margins. So far the chemical industry has fared rather better than other trades as regards re-equipment and modernization. Recent official utterances, however, suggest that the authorities will in future pay special attention to securing new plant for undermanned basic industries where mechanization is the only effective cure for labor shortages. As the supply of steel and equipment is strictly limited, this may well mean that chemical manufacturers will find it more difficult still to obtain new plant. The government has promised to buy machinery and apparatus abroad, but here again chemical manufacturers are unlikely to benefit.

The coal shortage cannot fail to impress itself on the export trade in chemicals. Shipments in January were better than in December and near the record level of last autumn, but this was only owing to large consignments of creosote oil, copper sulphate and ammonium nitrate, while soda ash and caustic soda were shipped in smaller quantities. In February and March when production was disrupted exports of some bulk chemicals had to be cut severely, and this loss was not offset by larger shipments of other products. The authorities certainly will do all in their power to stimulate export trade, but the difficulties are great and apparently not diminishing. Imports, on the other hand, are now arriving fairly smoothly, and lately included small amounts of dyestuffs from Germany. The fertilizer needs of agriculture account for a large proportion of imported bulk chemicals, especially potash salts of which also certain quantities are now being received from Germany.

Not least important among the effects of the coal and electricity crisis has been the stimulus it has given to research into fuel economy and alternative sources of heat and power. The conversion of boilers to oil is nat-

Drawing of the new plant for Shell Chemicals Limited to be built at Thornton, England



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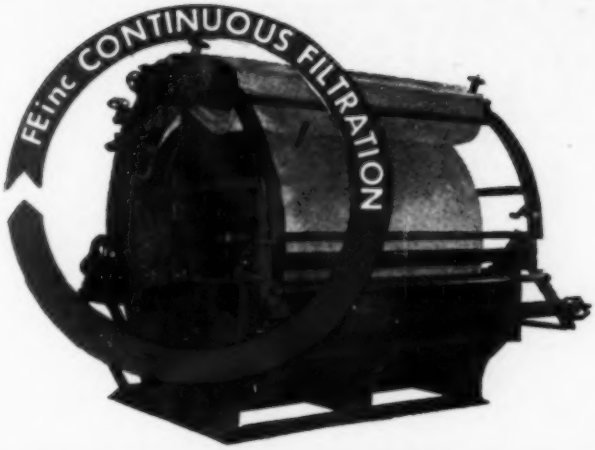
urally encouraged by the experience of the past winter, especially near the seaports, whereas gasworks are developing new processes to derive maximum output of gas from a given quantity of coal. Enrichment of gas with oil and suspension of scrubbing are among successful short-term expedients, while installation of new producer gas and carburetted water gas plant promises to bring long-term relief. The gas industry has suggested an impartial examination be made of the relative thermal efficiency of gas and electricity derived from coal before large-scale expansion plans are drawn up for either of these two industries. The fuel shortage also has given a stimulus to plans for further extension of the hydroelectric power stations in the Scottish Highlands.

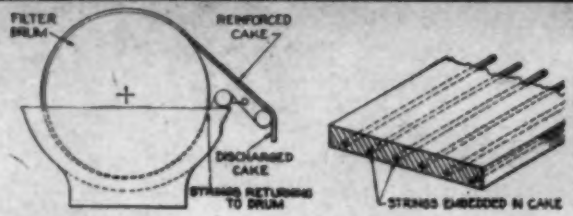
New Shell Project

In the meantime the mineral oil industry is proceeding with its plans for extended refining and manufacturing activities in the British Isles. The Standard Oil Co. of New Jersey and Petrocarbon Ltd. a few months ago announced big schemes, and now the Shell Petroleum Co. Ltd. states that work has started on a new factory for petroleum chemicals with an initial throughput capacity of 24,000 tons next year and a larger production later. The plant will cost several million pounds sterling and be situated at Thornton-le-Moors, Cheshire. The initial production range includes acetone, ketones, isopropyl, diacetone and secondary and tertiary butyl alcohols, and later a number of other chemicals, now in the laboratory stage, are to be made as well. Potential consumers have been informed that pilot plant quantities of these already are available for experimental purposes. Shell also has announced a number of extensions in progress or planned. The Stanlow refinery, on the Manchester Ship Canal, which makes sodium higher alkyl sulphates, is to be extended to 50,000 tons capacity; the output will thus have been quadrupled in a few years. The Shell Haven plant will be enlarged to a capacity of 30,000 tons of insecticides, fungicides and other products for agricultural use.

While the oil to be used as raw material as well as fuel in these new and enlarged plants will come from sterling sources, the products will replace, at least in part, chemicals at present imported from the United States, with a consequent saving of several million dollars of foreign currency. This consideration, very important in the present financial position of the country, probably favorably impressed the authorities when they licensed the new enterprise. It was facilitated by the recent exemption from import duty of



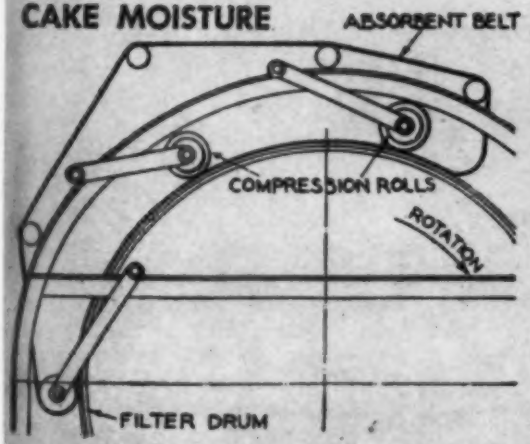
FEATURES THAT MAKE A GOOD FILTER – *BETTER*



STRING DISCHARGE

FE Continuous Rotary Vacuum Filters feature the string discharge that *lifts* the filter cake from the revolving drum in a continuous, uniform sheet. Does away with scrapers and "blow-back." No wire winding needed to hold the cloth in place, and no severe mechanical strain or abrasive wear on the cloth.

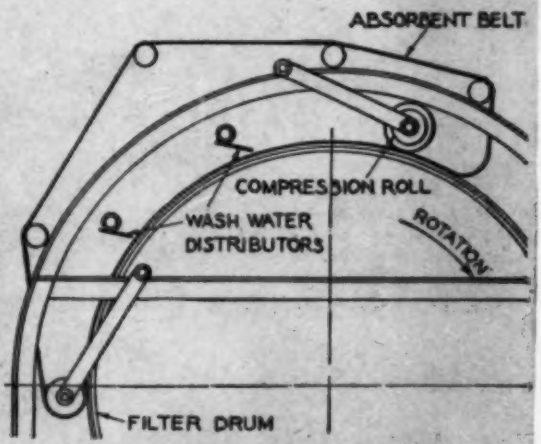
LOWER CAKE MOISTURE



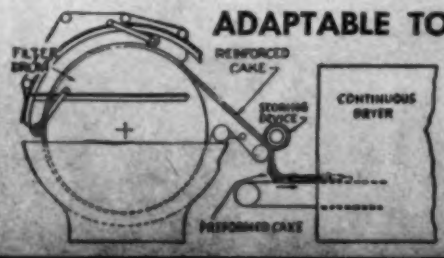
FE Compression Mechanism squeezes 2 to 6% more moisture out of the filter cake. It also reduces vacuum power requirements by closing up cracks that may occur in the cake. As shown above, it consists of segmented compression rolls that ride on a cotton duck compression belt on the exposed portion of the revolving filter drum.

BETTER WASHING

Less residual impurities, and better recovery of solubles in the filter cake are results with the FE Chemical Washing Filter. During the long washing arc, the filter cake is thoroughly flooded with wash water. All cracks in the cake are closed up so that the washing is uniform. Thorough dewatering gives you a clean cake with low moisture.



ADAPTABLE TO CONTINUOUS DRYERS



FE filters can be arranged to deliver filter cake that is preformed for fast, straight-line flow of material to any type of continuous dryer. Ask for details of FE Cake Scoring Device.

Filtration Engineers Inc. will be glad to show you many other ways FE Filters can improve your continuous filtration. Call on us.

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PUMP NOTES by DEMING

"SPECIAL" PUMPING JOBS ARE OFTEN "STANDARD"

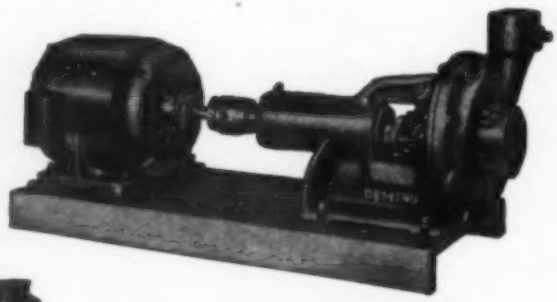
"SPECIAL" pumping jobs do not necessarily indicate the need for "special" pumps.

In numerous cases on record, Deming Pumps of standard design and construction are giving high standards of performance under conditions which the owners had good reason to think were "specialized" pumping jobs.

For example, the *standard* line of Deming Side Suction Centrifugal Pumps includes so many types and capacities that actual needs for a "special" pump are reduced to a minimum.

Two of many types of *standard* Deming Centrifugal Pumps are illustrated.

Illustration at right shows Deming Fig. 4003-M Side Suction Centrifugal Pump, direct connected to Electric Motor. Two ball bearing type with adjustable semi-enclosed impeller.



Illustrated below is the Deming Fig. 4003 equipped with a combination pulley suitable for either flat or "V" belt drive.

NEW BULLETIN NO. 3900-B

Write for a copy of this new, 8-page, 8½ x 11, illustrated bulletin which includes exterior and sectional views of single and two ball bearing types of Deming Centrifugal Pumps, ½", ¾", 1", 1½", and 2" side suction. Performance tables on Belt Driven and Motor Driven units are included in Bulletin No. 3900-B. Write for a copy.

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DEMING
INDUSTRIAL PUMPS

hydrocarbon oils used as raw material for chemial synthesis. The output of the new plant at Thornton will cover a substantial proportion of the needs of the British market and provide a surplus for exportation. Markets for this export surplus, it is stated, are now under development by Shell marketing organizations overseas. It seems likely that thus some of the chemicals produced by the Shell subsidiary in the United States will in future be available from British Shell plants. Whereas the base materials in the United States are obtained from natural gas or refinery cracking gas, the Thornton plant will start from petroleum base materials selected as most advantageously convertible.

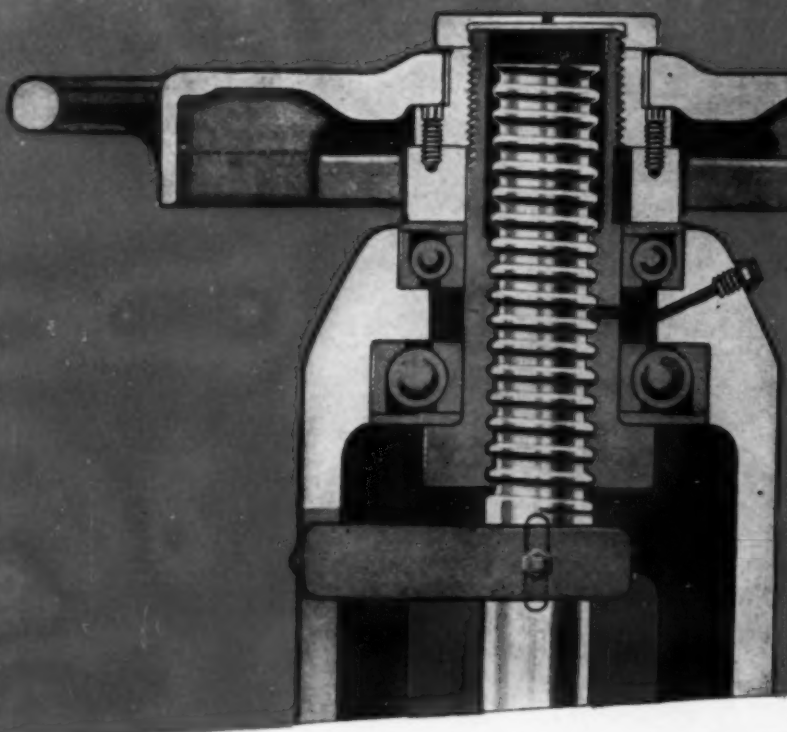
The new Shell venture into chemical manufacture will be based entirely, it seems, on imported mineral oils, while other recent enterprises in this field showed a general inclination to make provisions for alternative raw material sources. One company which ventured into this field expressly pointed to the advantage accruing from the possibility of treating either imported petroleum or coal derivatives or any other indigenous raw material, such as shale oil. The opportunities opening for the chemical utilization of coal are likely to attract some of the colliery undertakings which, after the nationalization of their coal-mining properties, will find themselves in possession of large liquid funds. One of these, the Powell Duffryn groups, one of the most progressive coal undertakings in Wales, already has indicated its intention to extend its interests in the coal carbonization industry and also announced plans for producing a range of carbon products. Its carbon plant at Hayes near London, a recent acquisition, soon will begin production, and the group may branch out into the manufacture of plastics and pharmaceuticals. A definite decision seems not yet to have been taken, but there is no doubt that interest in the chemical utilization of coal has grown rather than diminished as a result of the recent fuel crisis, and other former colliery companies may follow the example of Powell Duffryn.

Procter & Gamble to Operate Its Plant in Java

THE Procter & Gamble factory in Soerabaja, Java, one of the two plants which jointly are able to supply all the needs of the Netherlands Indies in the way of margarine and other fats, will be in full operation again as soon as it has received the 120,000 tons of coagulated fats it now has on order. Present annual fats consumption in the Indies is estimated at 6,500 tons, inclusive of army consumption.

ANOTHER EDWARD CONTRIBUTION TO BETTER VALVE PERFORMANCE

HOW Edward EValthrust YOKE BUSHINGS MAKE BIG VALVES EASY TO OPERATE even at high pressures and temperatures



Here are the advantages

The EValthrust yoke bushing is a heavy, high yield-point forging of aluminum-silicon-bronze with excellent wearing and non-galling characteristics. Hot forged as a single piece, it's distortion proof and can't get out of adjustment. Machining methods insure perfect alignment with the EValloy stainless steel stem.

Two angular contact ball bearings complete this compact, friction-free operating unit. The lower bearing takes the closing thrust; the upper bearing the opening thrust. Both, along with the strong external housing, take the radial load from the torque of the Impactor handwheel or motor control. Bearings are sealed from outside dirt, and a grease fitting permits lubrication. Threads of both stem and yoke bushing are an exclusive Edward form for dependable operation through a wide temperature ran...

YOKE BUSHING troubles and mortality began in earnest, especially on big valves, when very high operating pressures and temperatures became common. Something had to be done—and here was the Edward answer.

Edward developed the ingeniously simple patented EValthrust yoke bushing to facilitate the closing of big valves against tremendous pressures. With its companion unit, the patented Edward Impactor handwheel, the EValthrust yoke bushing gives maximum closing torque in minimum space.

In thousands of important installations throughout the country, EValthrust equipped Edward valves are busy, convincing proof that yoke bushing failures are wholly avoidable; that even the largest valves can be closed easily and tightly, though space is restricted and pressures and temperatures are extreme.

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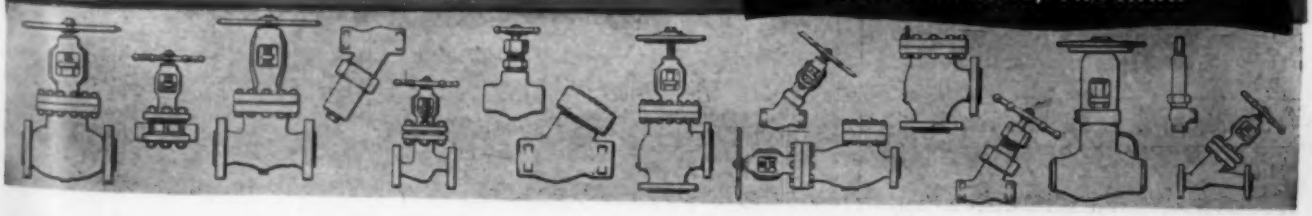

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  —not affected by most commercial acids — does not combine with usual components of high temperature alloys even on long contact at 2000° F.
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  Surface density approx. .05 lbs. per sq. ft. of approx. 3/16" thickness. Bulk density, approx. 4 lbs. per cu. ft.
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  0.00023 inches, average.
- RESISTANCE TO VIBRATION:
  Not seriously affected by extreme high frequency, high amplitude vibration of aircraft jet motor tail pipes.
- THERMAL CONDUCTIVITY:
  (graph on request)—at low temperatures — approx. 1/3 thermal conductivity of standard insulating materials. At 2000° F.—by far the lowest of all materials available.
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  Batt in rolls approx. 14' long by 3½' wide by 3/16" thick. *Cloth* in rolls of random lengths approx. 32" wide by 0.015" thick. Tapes, sleevings, and cordage of various widths and lengths. Loose fibers in bulk. Also, insulating blankets fully prefabricated by us to specification, either permanent or removal.

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SWEDISH CHEMICAL INDUSTRIES INCREASED FACILITIES OF RESEARCH LABORATORY DURING WAR YEARS

Special Correspondence

Wood is Sweden's principal chemical raw material. The country's leading export industry, the cellulose and paper industry, has been built up on the basis of this raw material. During the last few decades a more systematic organic chemical industry has begun to develop in conjunction with the production of cellulose. The next few years will show whether this new branch of production is capable of holding its own in competition with that of foreign countries based on coal or petroleum. These latter forms of raw materials also find extensive use in the Swedish industry and the rapid advance made in the acetylene technique, the production of shale oil and the refining of mineral oils in particular, encourage the hope that the Swedish industry will thrive in the organic field.

In contrast to the organic industry, Sweden's inorganic industry lacks the essential raw material, common salt. The supply has to be imported. Notwithstanding, the inorganic industry occupied a much more important position and was far more highly developed than the organic branch prior to the outbreak of the war. The electrolytic and electrothermal industries, which are likewise among the principal suppliers of inorganic products, are favored by the accessibility of relatively cheap electric energy.

Apart from raw material requirements, there is another important factor in connection with the Swedish chemical industry, namely, Swedish chemists. Sweden has produced many pioneer scientists in the field of chemistry, and from this point of view can more than hold its own. It is only during recent years, however, that chemical science and industry have established effective productive contact. Academically trained youth is seeking employment in the chemical industry to an ever-increasing extent and research work is occupying a more and more prominent and valued position in industrial activities. Even though the research budget of Swedish industrial undertakings is comparable only in a few instances with that allotted to the same purpose in other countries, Sweden has, nevertheless, succeeded in attaining a far more satisfactory research standard during the

New

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THE *UNSURPASSED* REFRIGERANT VALVE

For Freon Methyl Chloride
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PROVIDES on and off control of liquid or suction lines. Used with standard thermostats for positive control of refrigerants in either defrosting or reverse cycle systems, multiple temperature processes or with by-pass or unloading valves. Bodies are die forged and all internal parts are bronze or stainless steel.

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... and this duct of

TRANSITE INDUSTRIAL VENT PIPE

has never required maintenance

TEN YEARS AGO, the operators of the Dunellen, Plainfield and North Plainfield (N.J.) joint sewage disposal plant faced a serious maintenance problem. Every eight months, the duct carrying corrosive gases from the sludge-drying chambers had to be replaced. Then this plant installed the Transite Duct shown above ... and in 10 years not one cent has been spent for maintenance.

Strong and durable, Transite Industrial Vent Pipe successfully resists many of the corrosive gases, vapors and fumes met in industrial operations ... provides effective and economical venting service in a wide variety of industries.

You can use this asbestos-cement pipe outdoors or indoors, for it is rustproof and weather resistant ... needs no painting. Light in weight and readily assembled, it comes in 19 sizes from 2" to 36" in diameter ... with a full line of Transite fittings to assure corrosion-resistance throughout the system.

Data Sheet DS-336 gives full details and is free on request. Address Johns-Manville, Box 290, New York 16, New York.

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Boiler Works	Farm Machinery	Leather	Railroad	Soft Drink
Brewing	Food	Meat Packing	Rayon	Sugar Refining
Canning	Foundry	Metal	Refrigeration	Textile
Ceramic	Furnace	Mining	Rubber	Tool
Chemical	Furniture	Paint	Sewage Works	Water Works

Johns-Manville
TRANSITE Industrial Vent PIPE

war years than formerly. In the majority of the big Swedish concerns large research laboratories are now available or are being planned or built.

The results of this work are not lacking. This is illustrated by a few typical examples: In the micro-molecular field pharmaceutical raw materials and a number of other fine chemicals have been produced. Among other substances a whole series of different chemical products has been built up, based on ethyl alcohol. In the micromolecular field attention may be drawn to synthetic resins and synthetic compounds of a widely varying nature, including cellulose derivatives, synthetic rubber, acrylate resins, polyvinyl resins, etc. Several new plants have been built for catalytic and high pressure synthesis both in the organic and inorganic chemical industry and the Swedish installations for producing heavy chemicals and fertilizers have been extended considerably.

Chemical Employment

If such processes as the manufacture of cement, bricks, porcelain, glass, metals, cellulose, artificial fiber and provisions are disregarded, all of which are nevertheless mainly dependent on chemical processes and chemical technology, the more developed chemical industry provided employment for some 40,000 workers or about 7 percent of the total number of industrial workers. The productive value was 910 million crowns or 11 percent of industry's total production which slightly exceeded 8 billion crowns. The productive value per worker, as far as the chemical industry was concerned, lay approximately 60 percent above the average value for industry as a whole. Chemical imports amounted to about 440 million crowns, of which 150 million crowns consisted of raw materials. This constitutes 18 percent of the country's total imports and 48 percent of the domestic chemical production. Chemical exports amounted only to 77 million crowns or 4 percent of the total exports.

So far as chemical products are concerned the country is dependent to a high degree on imports. Before the war these included the following among other commodities, the figures referring to million crowns: sulphur and sulphuric acid with byproducts and certain other inorganic products, 63; fats, 63; paints and varnishes, 52; artificial fertilizers, 49; other chemical products, 39; rubber, 33; synthetic resins, 12; pharmaceutical preparations, 12.

For a large part of Sweden's imported chemical products, the supply of which began to fall off from the outbreak of war and ceased almost entirely during the period 1944-1945,

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122

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★ Sparkler Horizontal Plate Filters handle any liquid from heavy varnishes to light alcohols.

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it was possible little by little to provide substitutes within the country. As a result, the degree of employment in the chemical industry could be maintained at nearly 100 percent. Employment decreased in a number of industries, it is true, but compensation for this was found in the fact that other industries increased their activities far above what was their normal in prewar years.

It is impossible to determine in general terms to what extent the chemical products which have been developed under these special conditions are likely to survive in the future. It is obvious in many instances that such products are purely of a wartime nature. In many other cases, however, the outlook for the future appears promising. This applies particularly to extensions of a manufacturing process already initiated and to the recovery of new byproducts. But even certain products which are actually novel may be expected to survive insofar as they are in line with the development of the industry that has produced them. Reference should be made to new chemical products of a purely defensive nature, the manufacture of which will be continued in the future to some extent at least for military purposes.

The supply position at present is characterized by a marked shortage of a large number of chemical products, with the result that only a few of them can be exported. Among those available for this purpose, products of the wood industries such as turpentine, tar, etc., may be noted, as well as certain fine chemicals.

Record Nitrogen Production By Norwegian Company

ANNUAL statement recently released by the Norwegian electrochemical firm Norsk Hydro, Inc., shows production of nitrogen during 1946 to have topped all previous figures. Favorable supplies of waterpower are held largely responsible for the organization's record output of 88,500 tons of nitrogen during 1945-46, or 300 tons above the previous production high in 1929. A surplus of $2,100,000 is shown for the production year of which $40,000 has been set aside in a "Norsk Hydro Chemical Research Fund."

French shareholders have brought suit against the corporation to invalidate the 1941 capital expansion which took place when Norway was under Nazi control. Norsk Hydro in turn is bringing suit against the Norwegian Directorate for Enemy Property to clarify several questions concerning the corporation's liabilities in Nordisk Lettmetall and the former German corporate interests.

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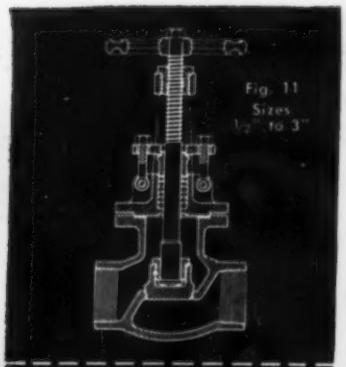

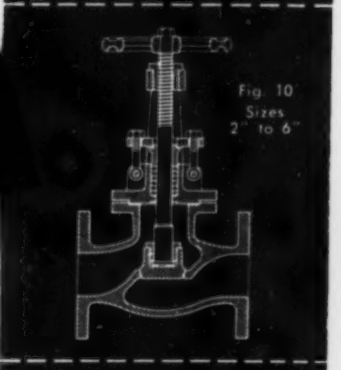

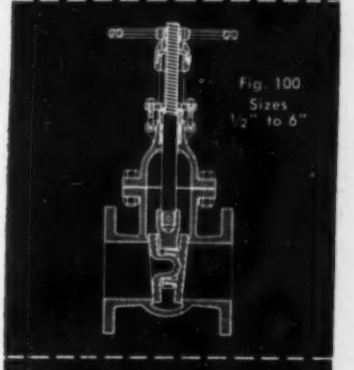

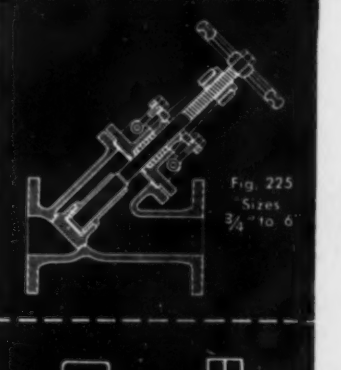

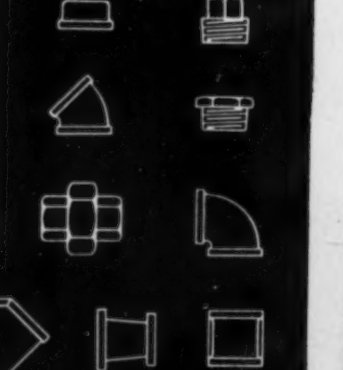

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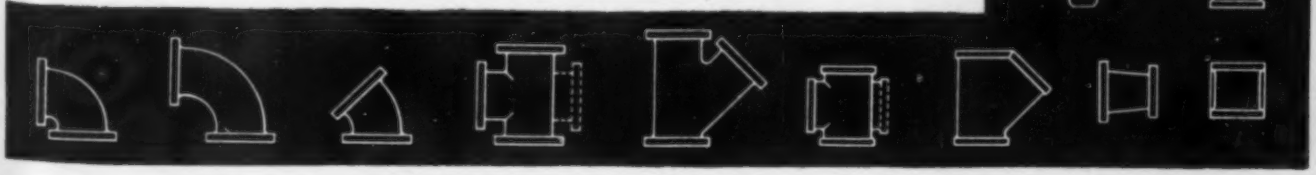

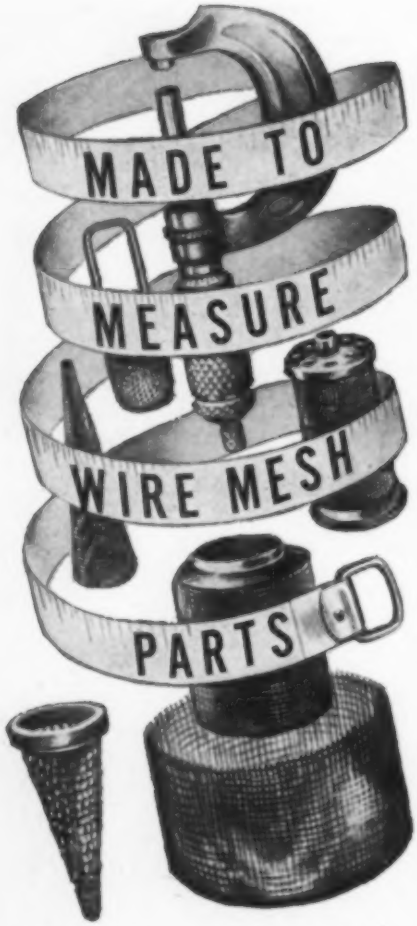

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CHEMICAL PRODUCERS IN WESTERN GERMANY BECOME MORE ACTIVE IN TRADE WITH OUTSIDE COUNTRIES

Special Correspondence

CHEMICALS feature prominently in the short-term trade agreements between occupation zones of Germany and other European countries, but quantities involved are small, deliveries are made largely from stocks, and these transactions on a governmental level are unlikely to lead automatically to a resumption of Germany's former large export business. More recently, however, some important export deals have been effected by firms in western Germany with overseas customers under the simplified procedure introduced by the Anglo-U. S. bi-zonal economic authorities.

Merck of Darmstadt received its first permit for an export of $800,000 of pharmaceutical products at the end of January, and since then other chemical manufacturers have been able to book important orders for various European and non-European countries through the official Foreign Commerce Offices. Chemicals also play an important part in inter-zonal trade. Thus a recent exchange agreement between Baden and Thuringia provides for the supply of crude chemicals from the latter region, situated in the Soviet zone, in return for pharmaceutical preparations from southern Germany.

Little information is available as regards shipments from the Soviet zone which includes the industrially important Province of Saxony-Anhalt. Exports from southern Germany included bauxite, salt, soda ash and cement; 15,000 tons of bauxite were sold from the U. S. zone to Norway, a transaction which was interpreted as indicating no early resumption of aluminum production was contemplated in the south German plants. Norway also was the first reported buyer of chemical plant from the U. S. zone; the transaction involved a nitrogen plant valued at $160,000. Dyestuffs and drugs have been shipped in fairly substantial quantities to France and in smaller amounts to Austria, Holland, Denmark, Sweden and Norway.

Although pharmaceutical manufacturers are expected to make a substantial contribution to German exports this year, the domestic supply is by no means satisfactory. Principal manufacturing centers now are Berlin, Dresden and Jena in the Soviet zone, Leverkusen in the British zone, and Hoechst,

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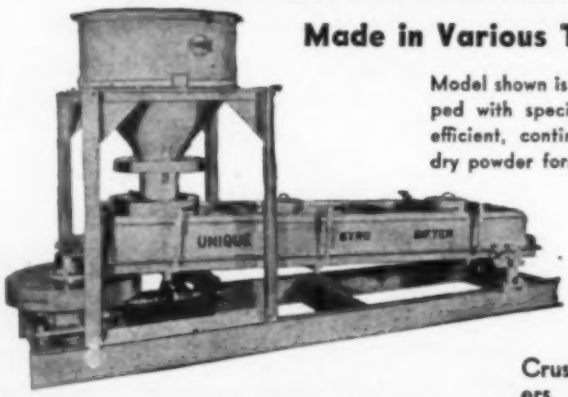

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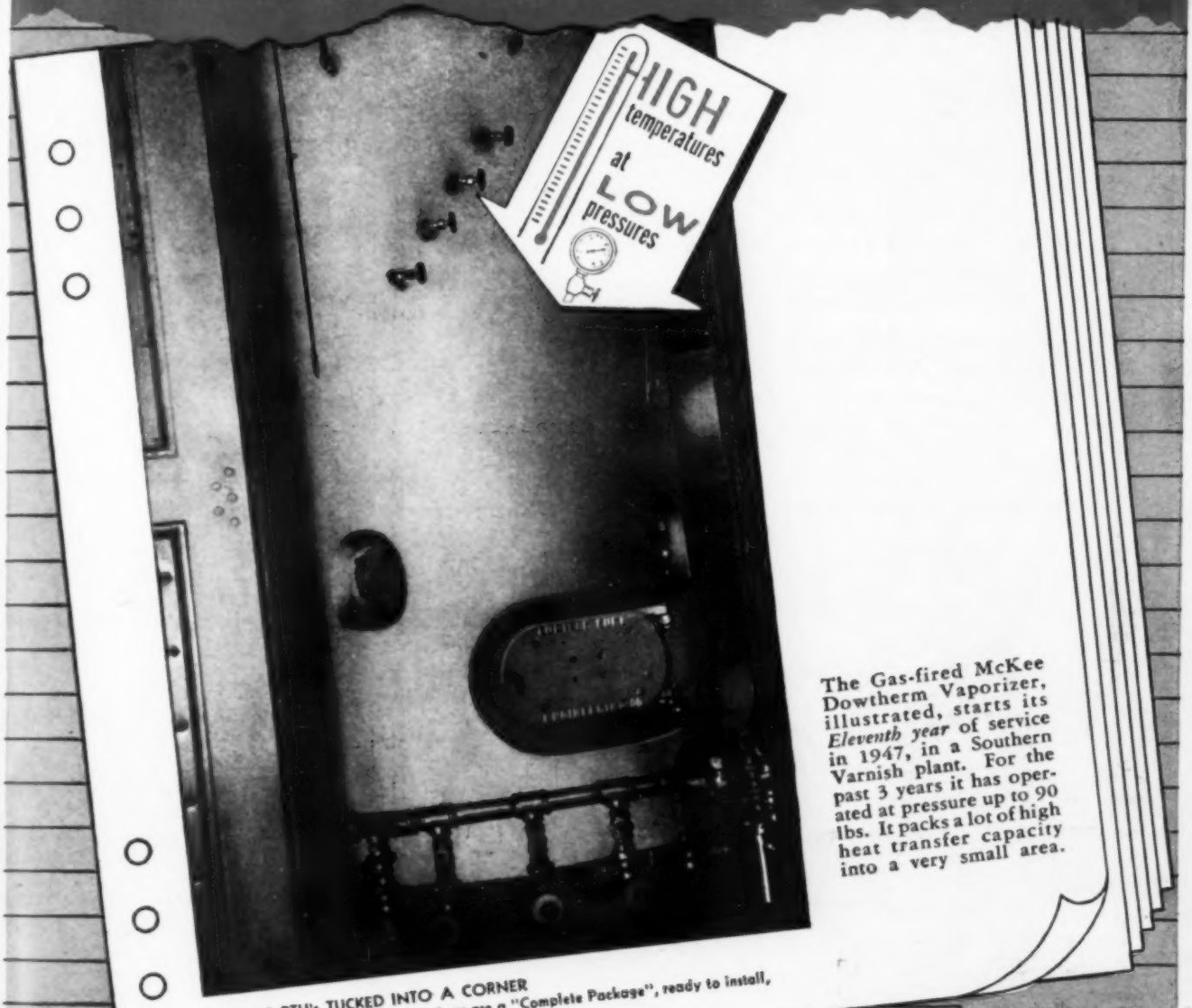

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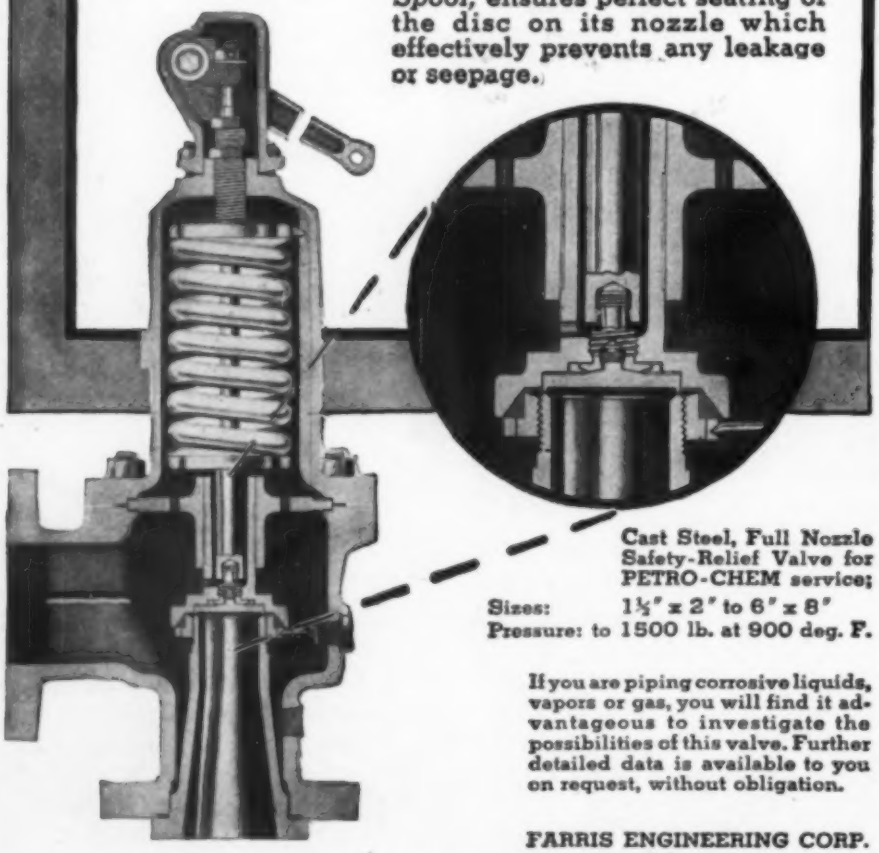

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Wiesbaden, Darmstadt and Frankfurt in the U. S. zone. Most of these works are not fully employed. Production in the Soviet zone is reported to be adequate as far as antiseptic preparations and vaccines are concerned, but there is an almost complete lack of sulfonamides, and opiates are short in all zones. Little progress has been made in production of penicillin, though several firms are now equipped for small-scale operation. Among these is Madaus of Radebeul, using the Heinrich-Gummel process. The firm has been expropriated by the Saxony Government on the ground of inadequate financial provision for social services. Several State enterprises in Saxony are to employ the same process of penicillin production.

Fertilizer Production

Main pre-occupation of the German chemical industry is the production of enough fertilizers to cover current needs and overtake wartime omissions. In the Soviet zone, for instance, 1,000,000 tons of agricultural lime are needed this year, but no more than 200,000 tons are available. 7,000-8,000 tons of crude phosphates will be obtained this year from Algeria under a trade agreement concluded between the Soviet Military Administration and the French Government and 6,000 tons of apatite from the Soviet-Union, but even so the supply of phosphatic fertilizers will not exceed 50,000 tons, one-fifth of prewar consumption in the Soviet zone, and part of this will be delivered to farmers only towards the end of 1947. The supply of nitrogenous fertilizers is to be raised to 120,000 tons this year, a little over half the prewar consumption, but this depends on adequate coal and lignite production. Only of potash fertilizer is there a sufficiency since exports on reparations account are to cease from the Soviet zone. Under the recent orders of the Soviet authorities potash production in central Germany is expected to rise to 800,000 tons of which 500,000 tons are to be used locally, while the remaining 300,000 tons are to be sold abroad to finance imports of other fertilizer materials.

In the western zones fertilizer production has been hampered by shortage of coal. Potash deposits in Baden supply just enough to meet the needs of the French zone, and the British and U. S. zones seem capable of producing rather more potash than are needed locally, but production of other fertilizers is still far from adequate. The cyanamide factory of Trostberg in Bavaria was one of the first to resume regular operations but had to close owing to non-arrival of coal supplies, and the big nitrogen fixation plants in the Ruhr suffered severely from the

Salt of the Earth!

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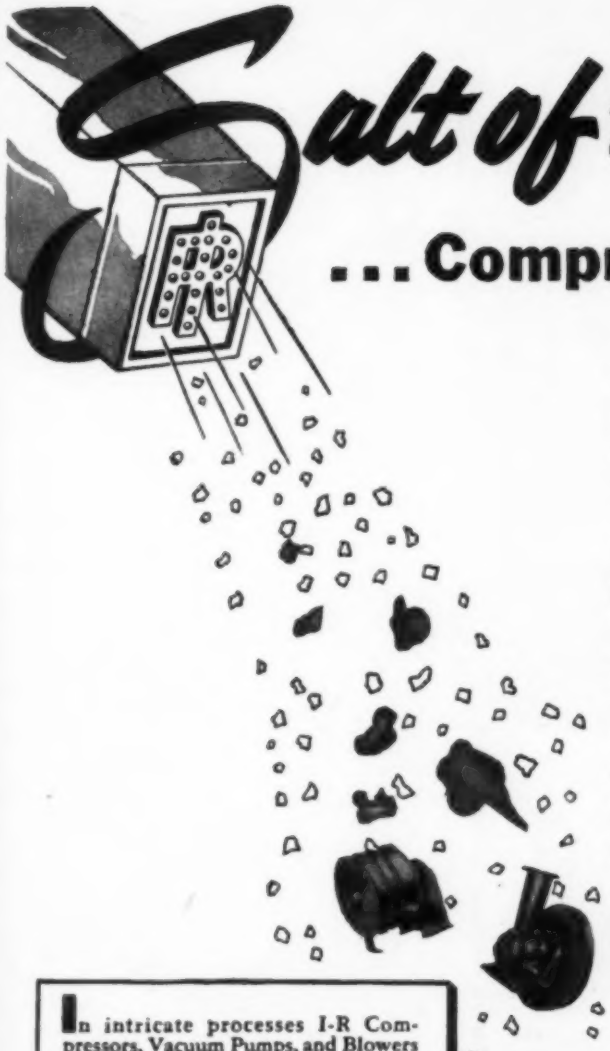

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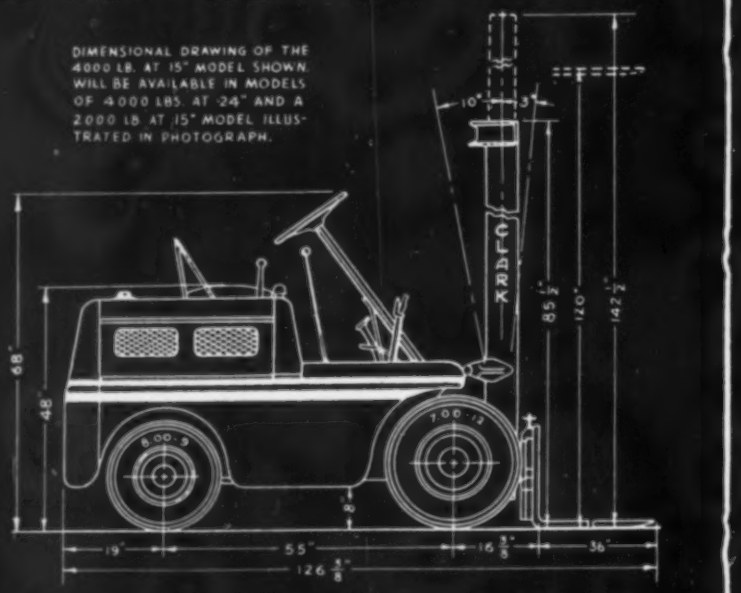

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fuel shortage. Fine chemicals makers are faring better in this respect. Thus the scarcity of coal does not prevent the I. G. Farbenindustrie works at Leverkusen, with 15,000 workers now the largest industrial enterprise in the British zone, from working to current capacity. A smaller firm, Chemische Fabrik Rodenkirchen, however reports that it is greatly hampered by raw material shortages, the supplies of methanol, aniline, sodium bromide, caffeine and citric acid fall short of requirements, partly because the firm's normal suppliers are located in other occupation zones.

Zonal differences also affect the organization of the chemical industry. I. G. Farbenindustrie enterprises in the U. S. zone are to be broken up into a large number of separate and independent economic units, if earlier plans are carried out. In the British zone, on the other hand, I. G. factories belong to the "controlled" industries which are exempted from "decartelization," and in the Russian zone I. G. plants seem to be operating under direct Soviet supervision and direction. Different treatment in different regions has led to a migration of big firms to areas considered more advantageous. Wintershall, the biggest German potash combine, has moved its headquarters from Hesse, where the State Diet has decided on the nationalization of big industrial undertakings, to the British zone, and the other two major potash producers, Salzdetfurth and Burbach, have moved their headquarters from the Russian to the British zone.

Large Pulp and Paper Mill In Monte Alegre, Brazil

THE recently constructed Klabin Paper Mill located at Monte Algere in the State of Parana, Brazil, is reported to be the largest pulp and paper mill in South America. Representing an investment of $10,000,000, it can produce 40,000 tons of newsprint and 40,000 tons of sulphite pulp a year as well as considerable quantities of kraft pulp and board. The construction of the mill was made possible through the cooperation of the governments of Canada, Brazil, and the United States, and through the teamwork of engineers and equipment and machinery companies of all three countries.

British Company Operates Silicone Pilot Plant

A SMALL pilot plant for the production of silicone materials has been installed in the research laboratory of the

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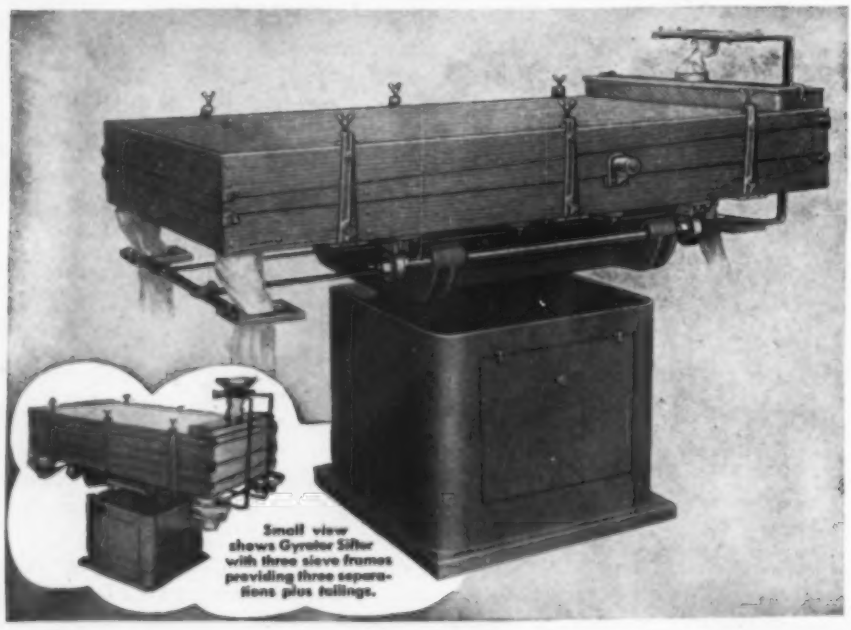

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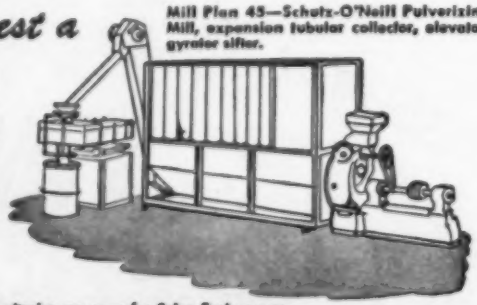

Mill Plan 45—Schutz-O'Neill Pulverizing Mill, expansion tubular collector, elevator, gyrator sifter.

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Foreign News Briefs

Foote Minerios Industrializados, Ltd., Brazil, has been formed to operate as a mining company and ore buying agency. It is an affiliate of Foote Mineral Co., Philadelphia and has offices in Rio de Janeiro and Victoria.

Monsanto Chemicals Limited has reopened its Manchester, England, office, which was closed shortly after the outbreak of war. It is under the management of M. E. Meredith, assisted by C. T. Randall, G. D. Sim and Mrs. Joyce Stevens.

Reichhold Chemicals, Inc., is erecting a resin manufacturing plant in Rio de Janeiro. The Brazilian company, Reichhold Chemica Industrial do Brasil, is headed by Dr. Mario de Oliveira Brandao and H. G. Levy, officers of James Magnus Ltda., Reichhold's present agent in Brazil.

Montecatini, the large Italian chemical firm, is reportedly considering affiliation with the newly formed industrial cooperative, Ufficio Sviluppe Esportazione. The latter organization plans to develop exports and build up foreign exchange.

The State chemical enterprise in Grodzisk-Mazowiecki, Poland, established a year ago, is now producing formaldehyde from methanol at the rate of 30 metric tons monthly.

Union Rheinische Kraftstoff A. G., at Wesseling, near Cologne, Germany, has received permission to produce 1,500 metric tons of methanol monthly. The product will be used as a solvent and in organic synthesis.

F. S. Mortimer, M.C., has been appointed head of the department of industrial and public relations of Monsanto Chemicals Limited. He was assistant general manager and has transferred his office from the Ruabon works to the administrative headquarters at Victoria Station House, London.

Ozalid (Aust.) Ltd., importers, exporters and manufacturers of sensitized products, has been registered in Victoria, Australia, with a capital of £10,000. The firm is to acquire by license or otherwise all or any rights, formulas and information from Ozalid Corp., a division of General Aniline and Film Corp., New York.

HYDROGEN PEROXIDE

Structural Materials, Manufacture and Uses

J. S. REICHERT and R. H. PETE

Electrochemicals Dept., E. I. du Pont de Nemours & Co., Niagara Falls, N. Y.

The Du Pont company has made a thorough study of materials of construction for handling hydrogen peroxide in all concentrations. This summary discusses the fitness of the various materials from the standpoint of both their corrosion resistance and their activity as catalyzers of peroxide decomposition. Stabilizers are suggested for those cases where they may prove useful as inhibitors of decomposition. In addition to considering structural materials, the authors bring us up to date on manufacturing methods and applications.

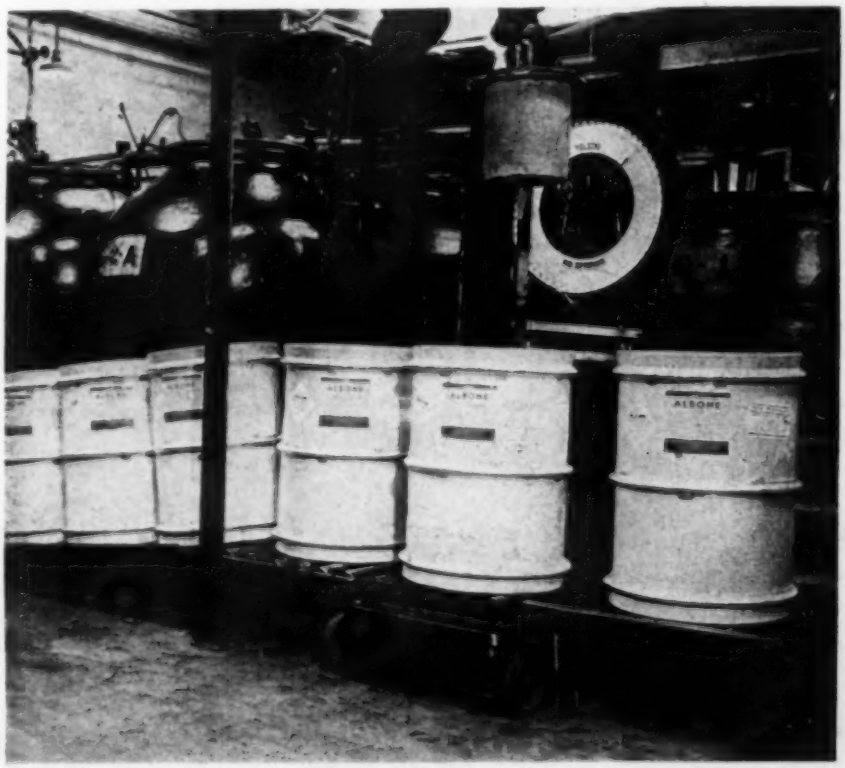
Success in manufacturing, shipping and applying hydrogen peroxide solutions in commercial uses depends largely on the selection of proper structural materials for processing equipment. Use of improper materials may lead to corrosion of equipment and also to accelerated decomposition and waste of hydrogen peroxide. Structural materials for handling and applying peroxide solutions must be considered a special problem for each particular set of conditions. One which performs very satisfactorily under one set of conditions may prove entirely unsuitable under other conditions.

From comprehensive studies of the various metals and nonmetals to determine their resistance to the corrosive action of hydrogen peroxide and also to determine the effect of these materials on the stability of hydrogen peroxide solutions, it is evident that there are very few structural materials which are suitable for handling peroxide solutions under practically all conditions of manufacture, storage and use. In most cases, it is the effect on the stability of the peroxide solution which is the governing factor in choosing compatible structural materials.

Pure solutions of hydrogen peroxide are inherently very stable. When carefully purified and kept in clean, unreactive containers, the rate of decomposition is extremely slow. In general, the stability of very pure hydrogen peroxide increases with the concentration.

Decomposition into water and oxygen is accelerated by a wide variety of catalysts. Among the more active and commonly encountered catalysts are lead, manganese, copper and iron. A slight trace of catalytically active material (parts per billion) will noticeably accelerate decomposition. Obviously, under commercial operating conditions such minute traces of catalytic materials, ever present in the surrounding atmosphere and in the walls of containing vessels, cannot be kept from entering the hydrogen peroxide solutions. Catalytic decomposition can, however, be inhibited by adding certain stabilizers to the solution. To be effective, a stabilizer must completely deactivate

Aluminum drums being filled with hydrogen peroxide



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the catalytic materials and must continue to function for the life of the peroxide.

In the following discussion each of the structural materials is handled separately. Due attention is given to inhibitors along with a description of the conditions under which the various materials will perform most satisfactorily.

ALUMINUM

Aluminum in contact with solutions of hydrogen peroxide is subject to two kinds of corrosion which must be inhibited or kept to a minimum. Uniform dissolving of the aluminum is kept at a minimum when the hydrogen peroxide is stabilized at the midpoint of the titration curve, or "neutral point." Corrosion is accelerated in both acid and alkaline solutions. The dissolving of aluminum by hydrogen peroxide at a pH below the neutral point is inhibited by pyrophosphate. The other type of corrosion which occurs, localized pitting, can be prevented by the addition of nitrates.

In order to prevent catalytic decomposition the aluminum should be 99.6 percent pure and free from foreign matter which may be embedded in the surface or included in the weld deposits. Before placing aluminum equipment in service it is necessary to pickle thoroughly with 35 to 42 percent nitric acid to remove all surface impurities. This pickling operation is critical and must be performed correctly. A peroxide storage tank will improve with age; this conditioning or aging effect may possibly be due to the build-up of an oxide film by the peroxide.

Aluminum which is 99.6 percent pure is being used for fabrication of shipping drums and storage tanks where contact with the hydrogen peroxide is over an extended period of time. For pipes, fittings, and tank cars where contact with the peroxide is for short periods, 99 percent aluminum is acceptable. Gas welding on aluminum equipment should be done with an oxyhydrogen flame, using 99.6 percent aluminum welding rods and a suitable flux. Shielded arc welding is being used satisfactorily with a 99.6 percent aluminum welding rod without flux; argon and helium supply the shield.

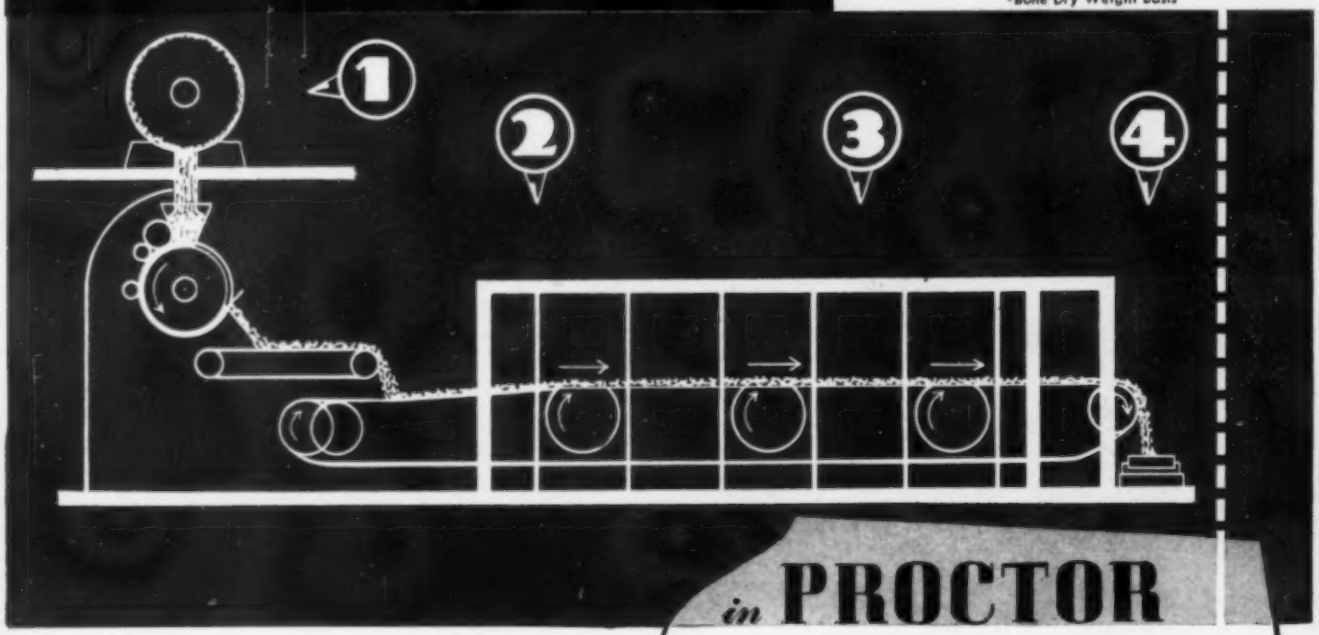
STAINLESS STEEL

Chrome-nickel steels, such as 304, 347 (columbium stabilized), 316 (containing molybdenum) and 316 Cb (columbium stabilized and containing molybdenum) are very resistant to corrosion by hydrogen peroxide under a

LEAD ARSENATE

REDUCED TO 0.5% (B.D.W.B.*) MOISTURE CONTENT AT RATE OF 1,000 POUNDS PER HOUR...

*Bone Dry Weight Basis



in PROCTOR *Continuous Conveyor System*

It is entirely possible to thoroughly dry lead arsenate to a uniform moisture content, and at the same time achieve tonnage production, by means of a Proctor continuous conveyor drying system with a preforming feed. Then, too, this continuous system minimizes dust in the atmosphere of the plant—a major consideration in the handling of this product.

Here is how one typical Proctor continuous system is employed for this purpose: ❶ The wet lead arsenate is first dewatered by means of a continuous centrifuge. ❷ From the centrifuge, the material is mechanically distributed into the hopper of the fin drum feed of the dryer. The paste-like substance is pressed into grooves of the internally heated, revolving drum of this feeding device. By means of this feed, the material will be sufficiently "pre-dried" so that it can be discharged to the conveyor of the dryer in the form of small "sticks" about ¼" square in thickness. ❸ Entering the dryer with a moisture content of 58.5% (B.D.W.B.), these "sticks" of lead arsenate lie in a bed on the perforated plate continuous conveyor of the dryer. The reduction of the material to the form of these small sticks makes it possible for heated air, at a temperature of 250° F., to circulate *through* the bed of material—thus promoting rapid diffusion and subsequent speedy, thorough and uniform drying. ❹ After 71 minutes of drying time, the "sticks" of lead arsenate are discharged with a moisture content of 0.5% (B.D.W.B.) —uniformly dried at the rate of 1,000 pounds (C.D.W.†) per hour.

This installation represents one more instance where Proctor engineers took facts gathered in the laboratory and translated those facts into a drying system that is meeting a need in the chemical process industries. Every Proctor system is literally "tailor-made" to meet individual product and plant requirements. If drying is a part of your plant operation, and you feel there is room for improvement in your present method—consult Proctor engineers without obligation. If you contemplate expansion, it will be to your distinct advantage to settle your plans for drying equipment early.

†Commercial Dry Weight

THIS IS A CASE HISTORY TAKEN FROM THIS NEW PROCTOR BOOKLET

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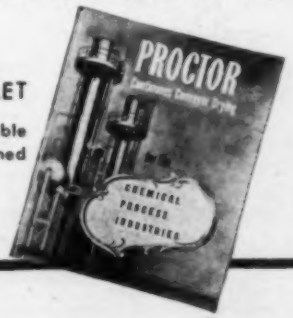

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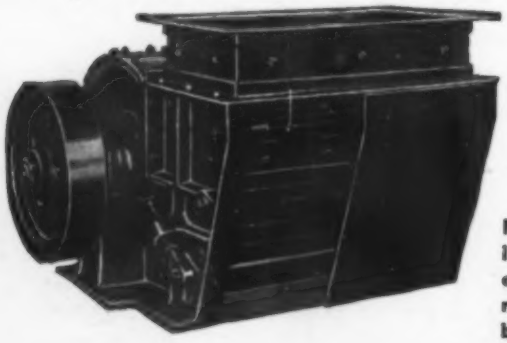

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wide range of conditions, i.e., neutral, acid and alkaline. However, these alloys have a mild catalytic effect on peroxide decomposition and are not generally recommended for long time storage of concentrated solutions. With strong solutions the loss in strength due to catalytic decomposition in stainless steel containers is likely to be appreciable under average storage conditions. With more dilute solutions of hydrogen peroxide (8 percent or less) stainless steel containers have been giving good performance. Stainless steel storage equipment should be pickled with nitric acid before use with hydrogen peroxide.

Stainless steel, with its excellent physical characteristics and its resistance to corrosion, is an excellent structural material for use with hydrogen peroxide solutions of strengths as high as 50 percent (and possibly higher) when contact with the solution is of short duration, e.g., in valves, pumps and pipelines. Stainless steel is also excellent for tanks and agitators for preparing dilute peroxide bleaching solutions and for tanks, vats and other equipment for bleaching operations.

TIN

Metallic tin is passive toward neutral and slightly acid solutions of hydrogen peroxide in concentrations up to 50 percent and possibly higher. It is corroded by alkaline solutions. Corrosion of tin by alkaline peroxide solutions is inhibited by the addition of sodium silicate. However, commercial sheet tin frequently has particles of iron scale or rust embedded in the surface which, if allowed to remain, will accelerate decomposition of the peroxide. The limitations in the physical characteristics of tin restrict its use; however tin is giving good performance in pumps, pipelines, tank linings, and other equipment.

TANTALUM

Tantalum is a suitable structural material for use with hydrogen peroxide under a very wide range of conditions as far as peroxide stability and resistance to corrosion are concerned. It has the disadvantage of high cost. However, there may be conditions when its initial high cost is offset by satisfactory service over a long period of time.

IRON

Iron equipment is satisfactory only under special conditions and then only with quite dilute alkaline solutions. Iron is subject to corrosion by hydrogen peroxide and is a fairly active cat-

200,000-gal. tank in two 100,000-gal. sections, with 200,000-gal. standpipe at base, for fire protection at large assembly plant.

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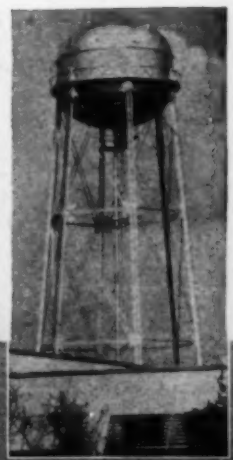
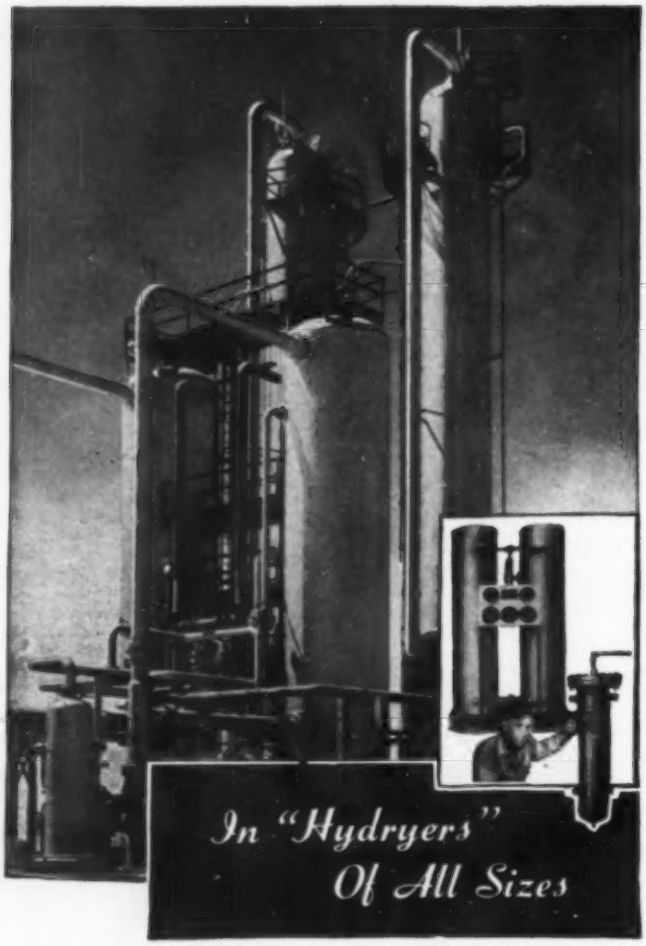
Hemi-ellipsoidal bottom 100,000-gal. tank on 84 ft. tower, El Paso Natural Gas Co.



Double ellipsoidal 150,000-gal. tank on 100 ft. tower, Walt Disney Studios.



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alyst for peroxide decomposition. When properly conditioned, corrosion of iron equipment is negligible in dilute alkaline solutions in the presence of sodium silicate. Under these conditions iron equipment is giving excellent performance in many bleaching installations.

LEAD

Under most conditions lead is susceptible to corrosion in contact with hydrogen peroxide. Lead is a very active decomposition catalyst in solutions where lead oxide can readily be formed. In lead equipment corrosion of the metal and catalytic decomposition are inhibited to some extent by addition of sodium silicate. Lead-lined tanks are being used successfully in the process for bleaching raw wool where sulphates are present to form lead sulphate instead of the catalytically active lead oxide.

COPPER, COPPER ALLOYS

Copper is a very active decomposition calayst and is also subject to corrosion. Copper equipment is therefore unsatisfactory under practically all conditions. Brass and bronze, like copper, do not give good performance. In some cases the copper in alloys does not act as copper and its catalytic effect is not so pronounced. Monel metal, which contains 30 percent copper, is being used successfully for some textile bleaching operations.

GLASS AND CERAMICS

In the non-metals group, glass and ceramic ware are widely used for hydrogen peroxide production and storage equipment. They are not attacked by hydrogen peroxide and when properly cleaned they have no adverse catalytic effect. Hydrogen peroxide in strengths up to 35 percent is being packaged and shipped in glass carboys; ceramic ware is giving satisfactory performance in storage containers. The fragile nature of these materials is the main limitation for their use with peroxide solutions. Acidproof tile tanks and tile-lined concrete tanks have been used very satisfactorily for the preparation and storage of bleaching solutions and also for bleaching tanks and vats. Acid and alkali resistant cement is recommended for construction of these tanks.

WOOD

Wooden tanks and pipes made of cypress and pine are fairly satisfactory for dilute peroxide solutions under many conditions. However, even dilute

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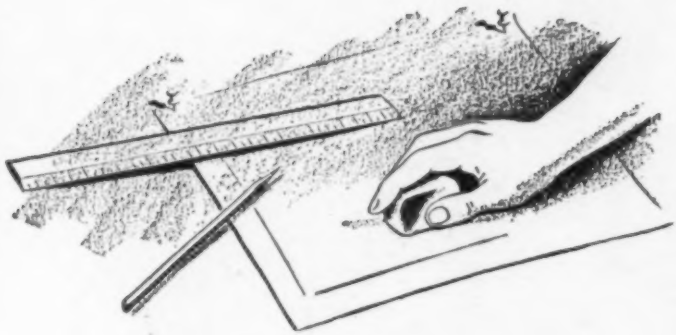

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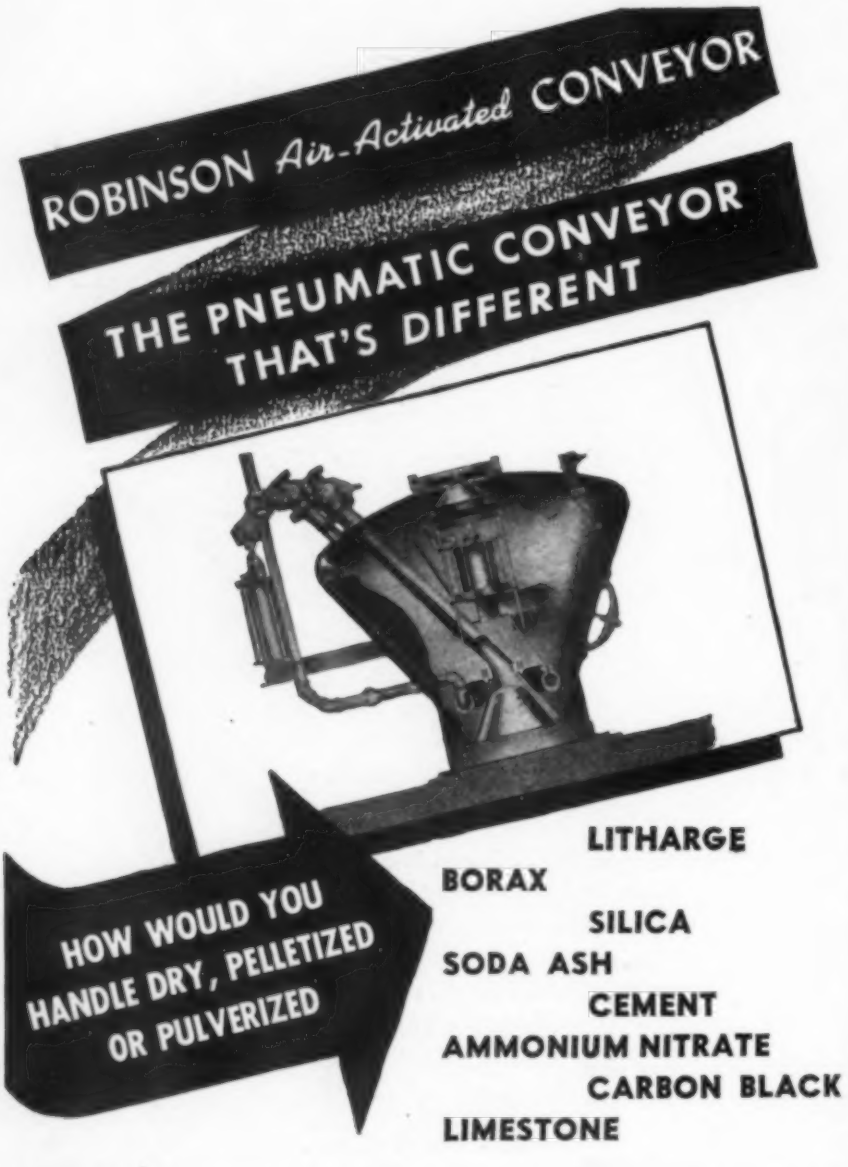

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peroxide solutions, especially at high temperatures and high alkalinities, swell and soften wood fiber, which shortens the life expectancy of wooden tanks to four to six years. For most satisfactory use, wooden tanks should be constructed with a concrete or tile bottom.

TRANSITE AND CONCRETE

Transite tanks and pipes are suitable for use with mildly alkaline, dilute peroxide in bleaching processes, particularly when sodium silicate is present in the bleaching solution. No adverse reaction between Transite and peroxide has been encountered over several years' use under these conditions. Concrete, like Transite, is suitable for use with dilute, alkaline solutions of hydrogen peroxide, particularly in bleaching solutions containing sodium silicate. Concrete equipment has been giving very satisfactory performance under these conditions.

Transite and concrete are not recommended for use with high strength hydrogen peroxide.

RUBBERS, PLASTICS, COATINGS

Most ordinary rubbers do not give satisfactory performance in contact with high strength hydrogen peroxide. The peroxide solution causes deterioration of the rubber and thus limits its useful life. The deterioration of the rubber is accompanied by acceleration of peroxide decomposition. Rubber hose has been used for dilute alkaline peroxide solutions, but the useful life of the hose is shortened to a period of one to two years. Natural rubber, as well as some synthetic rubbers, such as neoprene, may be specially compounded for use with hydrogen peroxide.

There are a few plastics which can be used for tubing and gasket material with dilute and concentrated hydrogen peroxide; among these are some of the polyvinyl chlorides, Teflon and polyethylenes. In general, coating materials are not satisfactory for use with concentrated hydrogen peroxide. The failure of most coating materials is due to the penetration of the peroxide through the coating to the base container where gas bubbles peel off the coating.

Paraffins of the saturated hydrocarbon type have no catalytic effect on peroxide decomposition and they undergo no deterioration in contact with hydrogen peroxide. As a coating material paraffin is difficult to apply and lacks good adhesive properties. White asbestos impregnated with paraffin or silicone stop-cock grease is recom-

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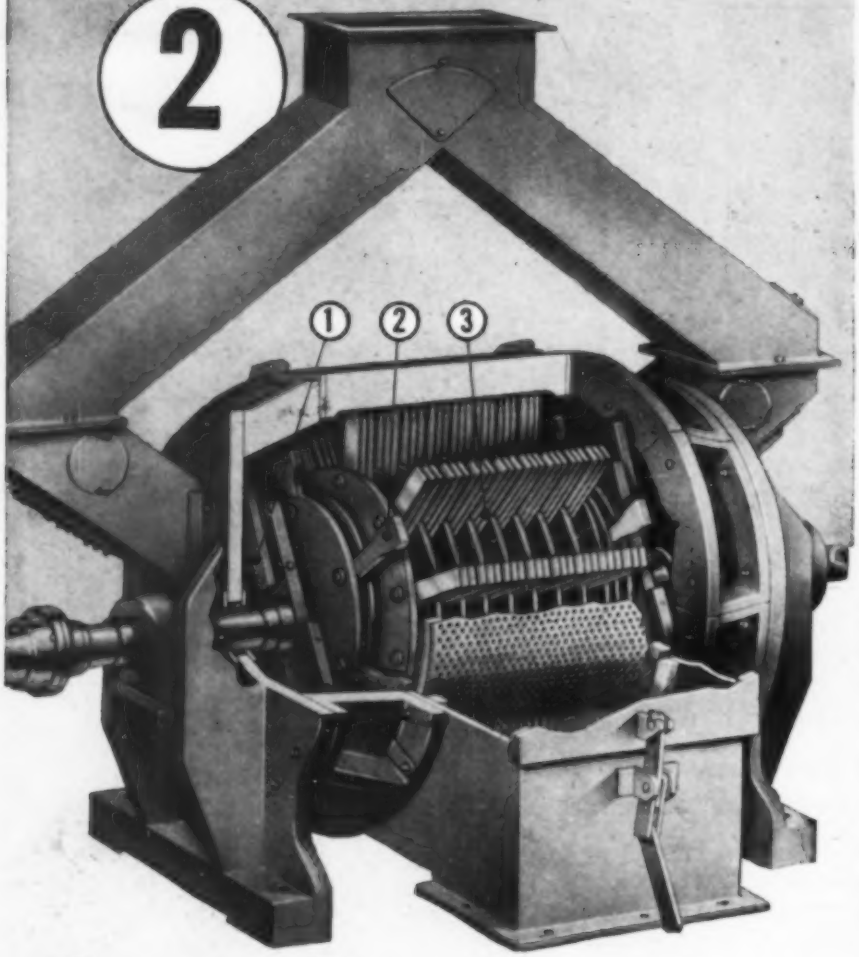

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MANUFACTURE AND USES

Hydrogen peroxide was first prepared by Thénard in 1818. Early U. S. production was limited to low concentrations, principally 3 percent for pharmaceutical uses. As special industrial bleaching applications developed, the strength of commercial solutions was increased stepwise, to 27.5 percent in 1925 and to 35 percent some years later. In these concentrations hydrogen peroxide came into wider use.

With the impetus from military needs for a liquid chemical propellant, production of 50 percent material reached substantial proportions during World War II. The trend in the requirements for still higher strength hydrogen peroxide for buzz bombs, torpedoes and submarines, led more recently to the manufacture of 70-92 percent material. Hydrogen peroxide has been prepared on a laboratory scale in concentrations up to 99+ percent.

Three basic developments have led to the manufacture of an extremely stable product and have had a leading role in extending the range of industrial applications. They are: (1) Improved methods for the manufacture of pure and essentially catalyst-free hydrogen peroxide; (2) stabilizing procedures by which incidental traces of catalytic materials in hydrogen peroxide are deactivated; and (3) use of structural materials which do not exert an adverse effect on the stability of hydrogen peroxide.

Manufacture—The oldest commercial process for the manufacture of hydrogen peroxide is based on the following series of reactions: (a) Conversion of barium carbonate to barium oxide in the presence of a reducing agent; (b) oxidation of the barium oxide to the peroxide by heating in an atmosphere of oxygen; and (c) reaction of the barium peroxide with phosphoric and sulphuric acids to yield hydrogen peroxide.

During the past two decades the manufacture of hydrogen peroxide from barium peroxide has been augmented by processes based on the electrolysis of sulphuric acid or an acid sulphate. In the sulphuric acid electrolytic process persulphuric acid is obtained in the anode compartment of the cell; the persulphuric acid is steam distilled, regenerating the sulphuric acid and vaporizing hydrogen peroxide which is recovered by fractional condensation. In two other electrolytic processes the electrolyte is ammonium acid sulphate in sulphuric acid solution, which on electrolysis yields am-

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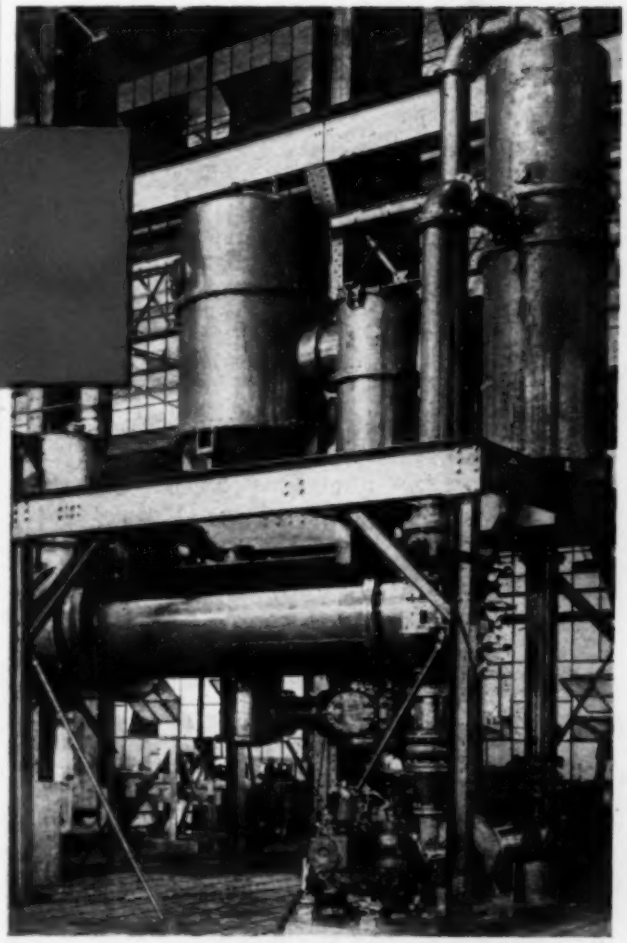

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Used with air operated instruments or auxiliary pilot units, the K & M KONTROL MOTOR regulates the flow of steam, liquids or gases — efficiently and sensitively. Send us your control problems. We'll show you how the KONTROL MOTOR valves will solve them. Write for new KONTROL MOTOR bulletin.

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KIELEY & MUELLER, INC.

2033 43rd St., North Bergen, N. J.

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monium persulphate. In one of these processes the ammonium persulphate from the cells is steam distilled directly to produce hydrogen peroxide, the ammonium acid sulphate being regenerated. In the other process the ammonium persulphate solution is reacted with potassium bisulphate to produce relatively insoluble potassium persulphate. The potassium persulphate is hydrolyzed with steam and the resultant vapors are rectified under reduced pressure and condensed to yield hydrogen peroxide. The potassium bisulphate is regenerated.

Storage—Commercial distribution and storage of 27.5 percent and 35 percent hydrogen peroxide has been standardized and the use of glass carboys, aluminum drums and aluminum tank cars for shipment is common practice. Aluminum storage tanks are proving very satisfactory for all commercial strengths of hydrogen peroxide. Stainless steel tanks have been used successfully for storage of 8 percent hydrogen peroxide. Storage containers of all types must be supplied with vents to avoid a build-up of internal pressure and to avoid contamination from the outside.

Applications—Hydrogen peroxide is widely used in bleaching processes, in oxidation reactions, and for inhibiting bacterial growth. Since water is the only byproduct from hydrogen peroxide reactions, it is the preferred oxidizing agent for many applications where the introduction of other byproducts is troublesome.

Of the many uses for hydrogen peroxide, bleaching is of greatest commercial importance. All types of cotton fabrics, in open width or rope form, are being bleached successfully and economically in a newly designed continuous peroxide bleaching system. In the cycle of operations, the cloth is prepared in the usual manner, saturated with caustic soda, squeezed to eliminate the excess chemicals, heated from the saturation temperature to the operating temperature by passing through a heater tube assembly, piled in an insulated stainless steel J-box, stored for about one hour and then pulled out and washed. This cycle of operations is repeated with an alkaline peroxide saturation and the cloth is passed through a second heated tube, piled in a second J-box for storage, washed and pulled to the white bin. In changing from one fabric to another, a shift to a lower or higher temperature is easily and quickly accomplished by the use of automatic controls on the heater-tube assembly. It is thus possible to run any fabric at the optimum temperature for quality and economy.

Hydrogen peroxide is also used ex-

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Immediate Delivery!

Due to a fortunate materials situation Bristol has been able to build a sufficient stock to offer *immediate delivery* of the following instruments:

- **Temperature Controllers (Thermometer and Pyrometer)**
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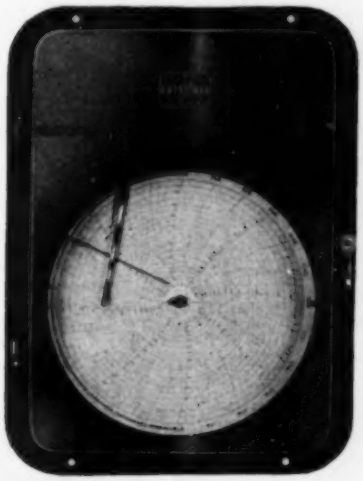
- **Recording Ammeters and Voltmeters**
- **Pyrometer Controllers (Electric and Air-Operated)**
- **Recording Gauges**
- **Recording Thermometers**
- **Running-Time Recorders**

Write for Stock Instrument Bulletin No. W1811. The Bristol Company, 109 Bristol Road, Waterbury 91, Conn. (The Bristol Co. of Canada, Ltd., Toronto, Ont., Bristol's Instrument Co., Ltd., London N.W. 10, Eng.)

BRISTOL RECORDING AND CONTROLLING INSTRUMENTS



THE BRISTOL COMPANY

Waterbury 91, Connecticut

Please forward your Bulletin W 1811 and Stock Lists as checked below.

- ☐ G600 (Gauges)
- ☐ T800 (Thermometers)
- ☐ B210 (Temperature Controllers)
- ☐ E1100 (Electrical)
- ☐ pH 1300 (pH Instruments)
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The time to get greatest value from Hicks cooperation in process engineering is while your ideas are still in flux. Write S. D. Hicks & Son Company, 1661 Hyde Park Ave., Boston 36, Mass.

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You Can Depend On KLEIN
FILTERS and FILTER LEAVES
• Positive Filtration . . . No Clogging
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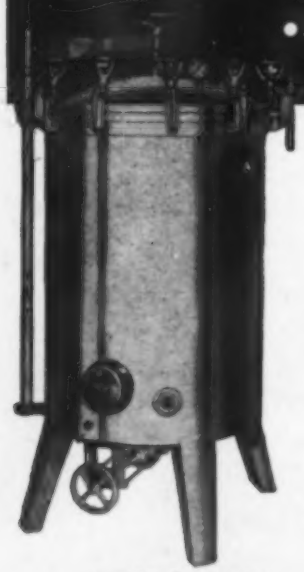

Klein Ideal Diatomaceous Earth Filters and the exclusive Klein Filter Leaves, in combination, assure positive filtration at all times. Operation, cleaning and maintenance costs are at a minimum with Klein Filters. In addition, many radical innovations are incorporated in Klein Ideal Filters. You'll want to know about all of these if you have an industrial, chemical or food filtration problem in your plant.

Write for latest Klein Bulletin

Klein Filter Leaf—If damaged, metal cloth easily replaced. No rivets. Note horizontal headers—central duct—Klein Cleanout Cap.

Established 1909
KLEIN
FILTER & MANUFACTURING COMPANY
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tensively in the wool bleaching industry although in some cases sodium peroxide can be used with a saving in chemical cost.

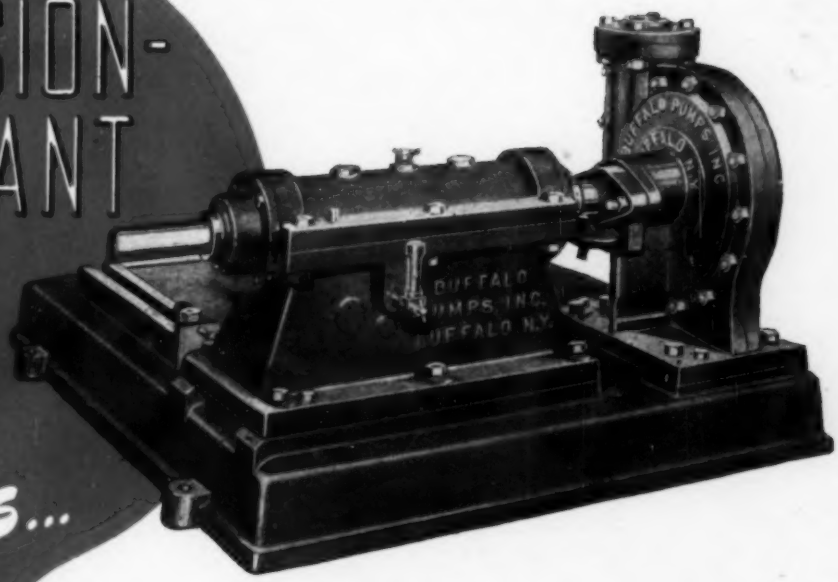
Scoured silk fabrics of all kinds, rayons, fur, hair, synthetic fiber, linen and minor bast fibers are also bleached with hydrogen peroxide. Groundwood, or mechanical pulp, is finding a wider use in paper manufacture since the development of a peroxide process for bleaching it; for economic reasons sodium peroxide is generally the preferred bleaching agent in this application. Articles manufactured from wood, such as veneers, furniture, tool handles, baseball bats and tennis rackets are being bleached with alkaline peroxide solutions. Commercial processes have also been established for the hydrogen peroxide bleaching of straw hats and braids, feathers, buttons, lanolin, beeswax, sausage casings, sponges, glue, molasses, fish, tripe, and lecithin.

In the chemical manufacturing industry, hydrogen peroxide is used to produce other peroxygen compounds, including sodium perborate, sodium percarbonate, calcium peroxide, zinc peroxide, mangesium peroxide, urea peroxide, and organic peroxides, such as benzoyl peroxide. In the purification of solutions of zinc, nickel or copper salts, substantially complete precipitation of iron without simultaneous precipitation of zinc, nickel or copper may be accomplished by adding hydrogen peroxide to convert the ferrous iron to the ferric state, adjusting the pH of the liquor to the proper value for precipitating ferric hydroxide, and filtering off the precipitated iron.

In the refining of sugar, hydrogen peroxide increases the life of bone char filters. Modified starches with improved dispersing characteristics are produced by a treatment with hydrogen peroxide. It is used as an oxidizing agent in the manufacture of dyes, sulphur chemicals for the rubber industry, and functions as a polymerization catalyst in the production of plastics and synthetic rubber. In nickel plating baths, small quantities of hydrogen peroxide stop hydrogen pitting, thus eliminating porosity. This quality also has application to certain other metal plating baths and it often assists in producing a more pleasing brightness to the plated work.

In dyeing textiles with vat colors such as indigo derivatives, anthraquinones, and carbazoles, sodium perborate and hydrogen peroxide are used as oxidizing agents to convert the dye to its insoluble form on the fiber and destroy the reducing agent employed to solubilize the dye. Hydrogen peroxide is used for desulphurizing oils,

CORROSION-RESISTANT *to these liquids...*



Liquid	Conditions	Materials Permissible
Acid, Sulphuric	to 50%	Lead, 5, High Silicon Iron
Aluminum Sulfurous		Lead, Sulphite, Bronze, Alum. Bronze, 4, 5
Aluminum Sulphate (Alum)	Containing Water & Acid	Lead, High Silicon Iron, 5
Ammonium Sulfate	With H_2SO_4	Lead, All Bronze, 5
Chloroform		Lead, 3, 4, 5
Copper Sulfate, Blue Vitriol	Aqueous Sol.	Lead, 3, 4, 5, High Silicon Iron
Ethylene Chloride	Cold	Lead, 5, High Silicon Iron
Ferrous Sulphate (Copperas)	Aqueous Sol.	All Iron, Lead, 5, High Silicon Iron
Magnesium Chloride	Aqueous Sol.	Lead, High Silicon Iron, 5 (Cold)
Sodium Bisulfate	Aqueous Sol.	5, Lead, High Silicon Iron
Sodium Hydrosulfite	Aqueous Sol.	Lead, 3, 4, 5
Sodium Hypochlorite		5, Lead, High Silicon Iron, Non-Metallic
Sodium Sulfide	Aqueous Sol.	All Iron, All Bronze, Lead, 3, 4, 5
Sodium Sulfite	Aqueous Sol.	All Bronze, Lead, 3, 4, 5
Sodium Thiosulfate	Aqueous Sol.	3, 4, 5, Monel, Lead, High Silicon Iron, Non-Metallic
Sulfur Chloride	Cold	All Iron, Lead
Zinc Electrolyte		Lead, 5, High Silicon Iron

• Extract From STANDARDS OF HYDRAULIC INSTITUTE, Data Section. For complete table, simply write us for bulletin 982.

• Do you handle any of the liquids indicated at right? Then you'll find a "Buffalo" Lead Acid Pump the answer to corrosion problems!

"Buffalo" Lead pumps are handling hot or cold sulphuric acid, alum, ammonium sulphate and copper sulphate very successfully in many chemical installations. Their three-inch-deep stuffing boxes; extra heavy casing walls and shells; oversize shafts and bearings; absence of close running tolerances mean high efficiencies and extra long life.

Also available in all iron or special alloys.

Why not write us concerning your pumping problem. We may well be able to solve it for you and save you money.

BUFFALO PUMPS, INC.

501 BROADWAY BUFFALO, N. Y.

Canada Pumps Ltd., Kitchener, Ont.

"Buffalo" LEAD ACID PUMPS

EASY TO POUR

These Por-Cans are particularly designed for packaging thin liquids. The seamed on heads and electric lap-weld construction provides unusual strength and guarantees against leakage.

The tight-sealed, easy pouring spout makes this container ideal for any liquid product.

PUSH-PULL SPOUT No. 594LPV has the same basic construction as the Swivel-Spout can, but the tube spout has advantages in handling some liquids.

INLAND STEEL CONTAINER CO.

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as an anti-chlor in shellac and textile bleaching, and for destroying residual sulphur dioxide in the manufacture of starch.

Corrosion Conference

THE 1947 University Conference on Corrosion and Metal Protection has been scheduled for June 11, 12 and 13, Museum of Science and Industry, Chicago. The conference is being sponsored by the following institutions, all of whom are currently engaged in corrosion studies: Carnegie Inst. of Tech., Illinois Inst. of Tech., Lehigh Univ., Massachusetts Inst. of Tech., Ohio State Univ., and the Universities of Chicago, Colorado, Minnesota, and Texas. Technical papers will be of a quantitative and research nature and will emphasize the scientific background of corrosion rather than the art of corrosion testing and practice. The program is as follows:*

"Bi-Metallic Corrosion," C. W. Borgmann, Univ. of Colorado.

"Mechanism of Overvoltage Phenomena," A. L. Ferguson, Univ. of Michigan.

"Surface Studies of Metals from the Corrosion Standpoint," M. G. Fontana, Ohio State Univ.

"Role of Adsorption from Solution in Inhibitor Action," Norman Hackerman, Univ. of Texas.

"Kinetics of the Dissolution of Metals," C. V. King, New York Univ.

"Some Concepts of the Mechanism of Corrosion Inhibitor Action," C. A. Mann, Univ. of Minnesota.

"Oxidation, Tarnishing and Surface Films of Metals," H. A. Miley, Watson Laboratories, Air Technical Service Command.

"Mechanism of Cavitation Erosion," T. C. Poulter, Armour Research Foundation.

"Corrosion of Bearings," C. F. Prutton, Case School of Applied Science.

"Bacteria and the Corrosion of Iron," R. L. Starkey, New Jersey Agricultural Experiment Station.

"Corrosion Protection by Phosphatization," M. A. Streicher, Lehigh Univ.

"Adsorbed and Reaction-Product Films on Metals," H. H. Uhlig, Massachusetts Inst. of Tech.

"Generalized Theory of Stress Corrosion Cracking," J. T. Waber, Illinois Inst. of Tech.

"Corrosion and Atomic Power," W. H. Zinn, Argonne National Laboratory.

Correction

This column, in November 1946, p. 256, lists 51S as one of the aluminum alloys that can be used for stills in the production of acetic acid by the destructive distillation of wood. The alloy so designated should have been 61S; 51S is another aluminum alloy with widely different properties.

*Requests for additional information should be addressed to Hugh J. McDonald, Illinois Institute of Technology, Chicago 16, Ill.

FROM THE LOG OF EXPERIENCE

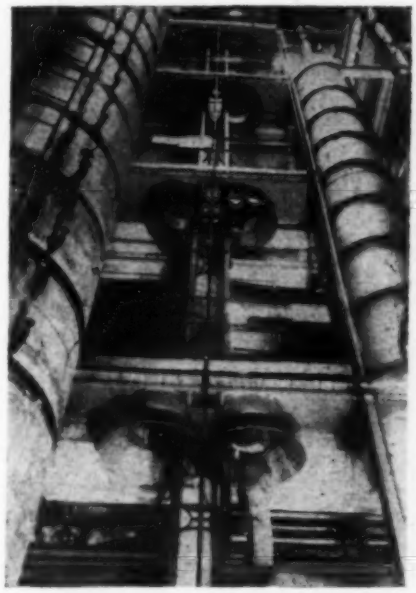
Dan Gutleben, ENGINEER

THE MANLIFT is subject to prejudice because it looks dangerous, but this very look inspires carefulness and safety. There is no tool that can equal its convenience in dispatching men in multifloor industrial plants. It substitutes cheap kilowatts for manpower now costing a dollar per hour for one twentieth of a horsepower or less. It makes vertical locomotion equal in ease to horizontal. If a tank overflows on the eighth floor, the foreman can reach it in a minute and save himself the nervous distraction of waiting for the platform elevator, or the alternative heart strain of negotiating the stair.

The platform elevator with its exasperating terminal stops compares with a batch process while the manlift is the modern efficient continuous machine. The capital outlay is a fraction of the price of a platform elevator. In a sugar house the total operating cost of the manlift, including R. & M., amounts to about fifty cents per 24-hr. day, although it does not stop day or night and is never out of order. Its use is so effortless as to invite frequent operating inspections of the plant by the supervisors and it provides for them, as they travel, a bird's-eye view of the performance of the men and machines.

AN ORDINARY sugar refinery employs 600 to 1,000 men ranging in mentality from the stupidity of a fish to the erudition of the chemist and there are included the physical and mental agility of the cat, the absentmindedness of the professor and the agedness of the "elder stateman," now 80, whom nobody has the heart to retire. There are samples of he-man robustness, sacroiliac weakness and high blood pressure. There are the cautious, the careless and the excessive elbow benders. It is the purpose of the manlift to improve the performance of all of these men and to administer to their comfort. It must therefore be guarded with safety devices to make it available to all. (See Code, page 234.)

EXPERIENCE of the past 25 years with seven manlifts has shown that there are required a few years of education during which some accidents had to be endured, a few of which were distressing but none very serious. These



Manlift in distillery. It's not as dangerous as it looks. On p. 234 is a code based on data from state officials, manlift builders, 100 users

accidents led to mechanical safeguards. The engineer's exhortation to carefulness and the large, snappy, short-sentence rules, installed where all who ride may read, were occasionally reinforced by the well publicized discharge of a man who suffered injury by flagrant disregard of the rules. There is no way in which a manlift can sin against safety except by the connivance of the rider. Carelessness exacts a price and the machine is an unwilling accessory.

GRAIN ELEVATORS and flour mills, whose function is best served by a vertical arrangement, are fitted with manlifts as naturally as a cat is fitted with a tail. Every state west of the Ohio River and south of the M. & D. line is free of restrictions to the use of manlifts except reasonable safety codes to which the installations must conform. Where manufacturing plants are deprived of the economy and comfort of this device it is due to prejudice. Furthermore, the manlift usually comes under the cognizance of the elevator inspection department and there are cases where the zealous officials find it impossible to reconcile the installation and operation of this totally different machine under the rules and so the machine is condemned. It should not be subjected to the judgment of a man possessed of a complex of fear induced by stiff bones and hardened arteries.

In an eastern state where the chronicler sought to install a manlift objections came from the state safety inspector who replied that the American Safety Code made no provision for manlifts and therefore implied condemnation. The remedy in the latter case is to find the facts and deliver them to the Committee for action. There are now some thousands of manlifts in use throughout the land and they are serving every kind of manufacturing plant.

THE "FORM" of a sugar refinery follows a vertical arrangement and accordingly requires means for vertical travel. For the steam plant (118 ft. high), the melter, pan and char houses, the packing plant and the distillery, the Pennsylvania refinery employs seven manlifts. In addition there are also a number of platform elevators which provide for freight traffic and the convenience of visiting "bond holders." Transportation-wise, the stairway is the good old indispensible horse, the elevator is the combination railway car and the manlift is the airplane. The seven manlifts travel an aggregate of 50,000 miles a year and provide a million rides. After an educational period of ten years the accident rate dropped to nearly zero and the time saved, not to mention relief to tired old legs, has been prodigious.

UNUSUAL EXPERIENCES of the early period start with an inebriate. He placed one foot on the descending step and then forgot what he had in mind. The step left him with his body sprawled across the floor opening and one leg dangling through. His guardian angel chanced to be on duty. Just as the succeeding step was about to make contact, the superintendent happened along and pulled the stop rope. Some blame attaches to the foreman in such a case but the inebriate was discharged.

A thoughtless oiler leaned over the

"It's easy to put lab fires out— if you catch them in time"

Could a fire in your laboratory—starting as a small blaze—quickly flare up into a serious one?

Ask a Kidde representative to show you how quickly and easily incipient lab fires can be smothered—with a *Kidde* Portable Carbon Dioxide Extinguisher!

Talk to the Kidde representative, too, about other fire hazards in your plant. You may gain some helpful ideas from his thorough knowledge of fire protection problems and extinguishing equipment.

And you can be sure that the equipment he recommends—result of years of experience in design and application—will be fast and sure in action against electrical or flammable liquid fires—that it will be safe, non-corrosive, non-damaging. Remember . . . carbon dioxide is deadly to fire, harmless to everything else!

Walter Kidde & Company, Inc., 428 Main Street, Belleville 9, N. J.

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Kidde

FIRE PROTECTION HEADQUARTERS

rail on the descending side to satisfy his curiosity for a view down the hatch. The next step bumped his head. In this case the railing on the descending side of the belt was fitted with an extension.

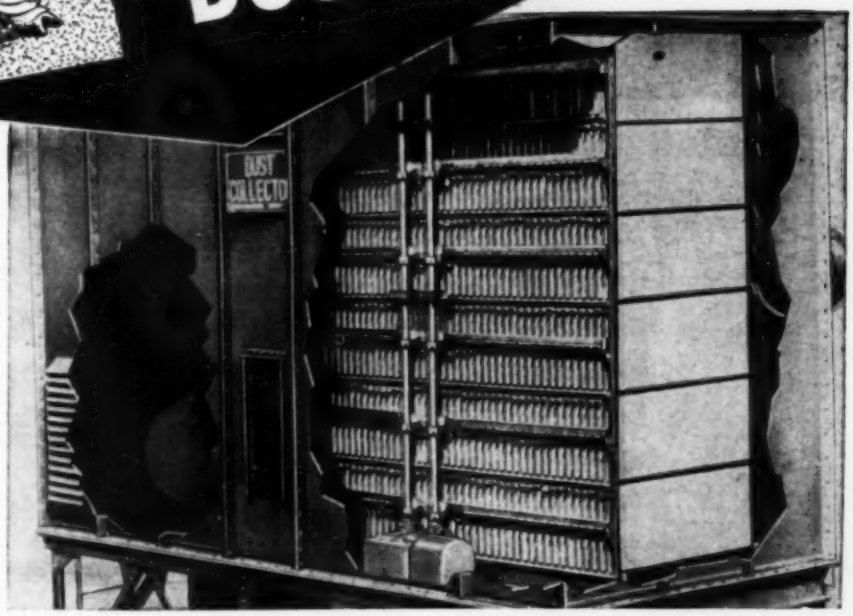
A 250-lb. amateur boxer of glorious athletic form made a dash across the room for a certain descending step and when he arrived at the belt he jumped onto the step which by that time was 3 ft. below the floor. The step broke off and the athlete dropped like a plummet to the floor opening where his outstretched arms held him, but in his dazed condition he neglected to pull the stop rope. Nobody happened to see him till the succeeding step pushed him through and inflicted injury that cost a few weeks of lost time. Following this, labyrinthine railing was provided around floor openings and the cast iron step brackets were replaced with steel. After this another amateur was seen vaulting over the railing. He made his step without mishap. In this case the rail could have been made higher and topped with barbed wire but instead the man was discharged and notice of the facts posted on the bulletin board.

In another case the employment manager picked up a 68-yr. old casket maker with palsied legs and accepted his claim that he was a construction carpenter. The foreman neglected to give the new man the usual instructions but proceeded absentmindedly up the manlift. The new carpenter followed and when he had passed the next floor he observed his boss walking down the aisle. Instead of continuing to the next landing the new man became confused, jumped and broke his leg. This one was on the foreman.

ADDITIONAL ACCIDENTS of minor nature have been experienced, but in the past 15 years there has been no lost time injury. This has been the price for 25 years of use. Since there is only one safe way to use the manlift and a number of wrong ones, it is essential that no new employee be permitted to use it till he has been thoroughly instructed, and this requirement has been added to the rules included in the safety code on the next page. An almost negligible accident experience is reported by the Crockett, Calif., refinery having 1,500 employees. Similar reports come from America's largest producers of flour, corn products, food, chemicals, cement, beer, liquors, industrial alcohol, electric equipment, power service and from a great number of public garages. The experience is furthermore reflected by the low rates of insurance applied by insurance companies.

(See Manlift Code, Page 234)

Here's Your DUST TRUST BUSTER!



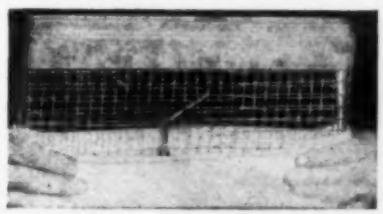
IT'S the Pangborn Dust Control System—with the exclusive features that put a positive end to the excessive prices you pay for unwanted dust.

The "CH" Collector is the heart of the system. As dust-laden air is drawn (or pushed) into the collector, it hits a baffle plate, its velocity is retarded, and the heavier particles drop into a hopper. Air carrying the lighter particles flows into channels beside cloth-covered screens placed in a grid partition. As the air passes through the screens, it deposits the remaining dust on the cloth and emerges dust-free.

CLOTH CAN'T COLLAPSE

One of many exclusive features is the all-steel, rust-proof wire mesh frame (electrically grounded) which uniformly supports the cloth and positively prevents collapse under air load. The supports are close together and the wire mesh is securely fastened and reinforced—so there's no chance for the bag to sag, no chance for the sides to touch with resultant reduction in filtering area and increased resistance to air flow.

Send at once for free 28-page Bull. 909A, giving complete story on Pangborn equipment which has successfully solved dust problems in over 9000 installations. Address Pangborn, *world's largest manufacturer of dust control and blast cleaning equipment* at 283 Pangborn Boulevard, Hagerstown, Maryland.



Cloth bag fits over wire mesh screen frame. Crank-shaped beater rod cleans cloth by alternately rapping opposite wire mesh surfaces (without touching cloth itself).

Pangborn
DUST CONTROL
PANGBORN CORPORATION. HAGERSTOWN, MARYLAND

TURNS DUST LOSSES INTO PROFITS

Gutleben's Manlift Code

(1) Worm gear using a factor of safety of 15. Extended shaft is preferred but motor may be connected to worm either by flexible coupling or V-belts of ample strength. Alternate: Spur helical or herringbone gears may be used. In either case a spring-actuated solenoid-release brake is to be installed to operate when power is off.

(2) Head shaft not more than 5 ft. above top floor to warn ascending rider to get off.

(3) Automatic overtravel stop arranged to throw current breaker and apply brake, thereby stopping belt within 8 in. of travel in case the rider is not off the step 18 in. above the top floor. The motor cannot be restarted except by manually closing the breaker at the top floor.

(4) Steel stop rope, full length of manlift, to operate the above stop when pulled in direction of travel.

(5) Belt not less than 12 in. wide, 6 ply, 36 oz. duck, rubber covered. Explosive fumes may require special belt and grounding of entire machine.

(6) Max. speed of belt, 80 ft. per min.

(7) Handgrips are shrouded and mounted so as to be open above the steps either ascending or descending.

(8) Standard hand railing with 6 in. toe boards, arranged with staggered openings either on one or both sides. Use long radius bends in lieu of newels to avoid entangling clothing. If space is limited, self-closing, spring controlled gates opening outward may be substituted for staggered rail opening. Railing may be covered with screen to guard against falling objects.

(9) Floors inside of railing have non-skid surface or approved mats.

(10) Floor openings will not be less than 30 in. dia.

(11) Sheet steel funnels will be installed under each floor opening to serve as head guards and fire stops.

(12) Min. dia. of head and foot wheels, 20 in.

(13) Min. clearance under foot wheel and step, 12 in.

(14) If low ceiling in basement requires a pit it must be large enough to permit a forgetful rider to step out of the way of the next descending step.

(15) The bottom landing may be guarded by automatic overtravel stop similar to the top.

(16) Push button switches may be installed at each landing if desired to stop and start the belt.

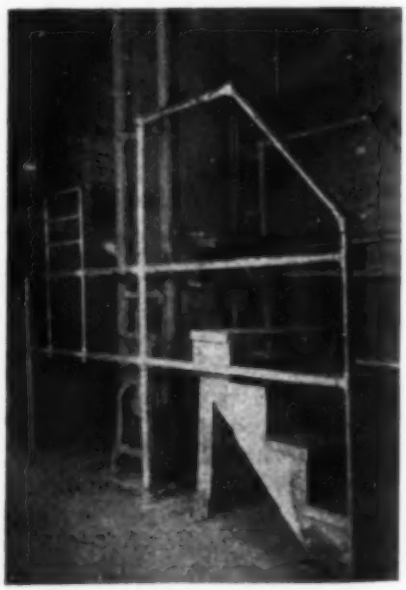
(17) Minimum factor of safety of structural parts will be six.

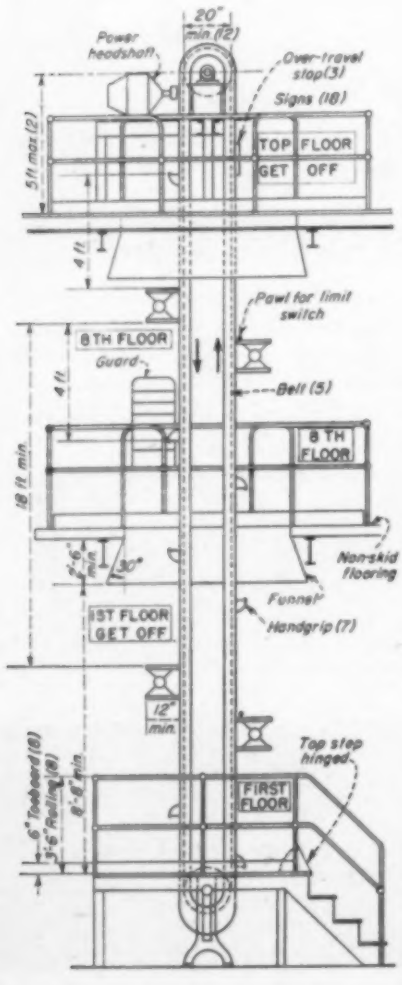
(18) Floor signs must be prominently displayed.

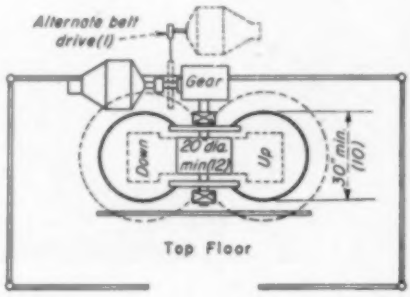
(19) Modification to suit special conditions may be considered by the State Safety Department provided it meets the minimum safety conditions here set forth.

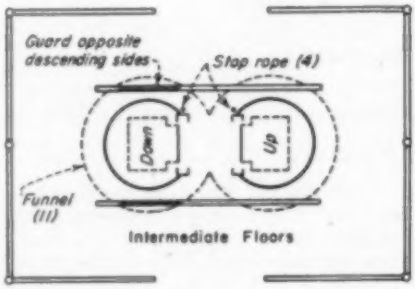
Rules: Employees Only. Visitors Keep Off. Face Belt. Hands on Grip. New Men Keep Off Till Instructed. No Materials Except Hand Tools. No Horseplay.

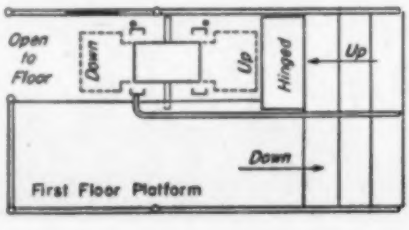
Top and bottom of manlift before "labyrinthine" railing was put up

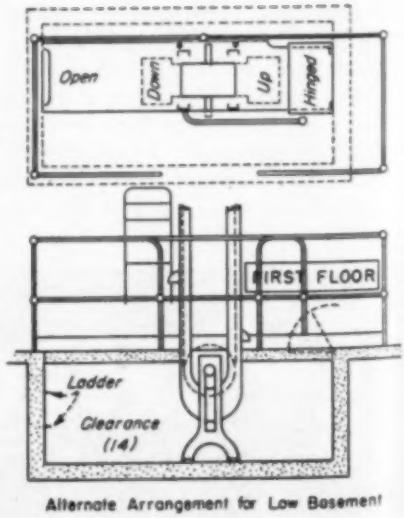












Alternate Arrangement for Low Basement

NAMES IN THE NEWS

C. G. Kirkbride

C. G. Kirkbride has resigned from Texas A. & M. to accept an executive position in connection with the research and development activities of the Houdry Process Corp. in Marcus Hook, Pa.

Theodore W. Evans has been named manager of the Emeryville (Calif.) research laboratories of Shell Development Co. He succeeds **Walter J. Hund** who died February 17. Dr. Evans joined the Emeryville staff in 1930 and was appointed an associate director of research in 1942.

Samuel Cottrell, of the administrative staff of the American Potash & Chemical Corp., has been appointed to the post of vice president in charge of technical operations. Mr. Cottrell joined the company last year after 25 years of service in the chemical industry. His last previous position was assistant manager of the Monsanto plant at East St. Louis.

H. J. Fraser and **H. J. French** have been elected vice presidents of The International Nickel Co.

Charles Allen Thomas, vice president and technical director of Monsanto Chemical Co., was named as the second recipient of the Industrial Research Institute Medal. The medal is given for an outstanding contribution to the field of industrial research. The presentation will be made to Dr. Thomas at the annual meeting of the Institute in June.

Norman A. Shepard, technical director of the American Cyanamid Co., sailed March 22 with **Leonard P. Moore** to spend several months in England in organizing technical representation of American Cyanamid Co.

H. K. Clark, formerly executive vice president of The Carbonundum Co., has been elected president of the company to succeed **Arthur Batts,** who has been elected chairman of the board.

James FitzGerald has been promoted to the post of assistant chief chemical engineer of the Brunswick-Balke-Collender Co.

Frank E. Lobaugh, formerly technical service manager, has been appointed technical service director of the Lumnite division, Universal Atlas Cement Co.

George E. Felton of the Hawaiian Pineapple Co., has been elected chairman of the Hawaiian Section of the American Chemical Society. He succeeds **Hugo P. Kortschak** of the Hawaiian Sugar Planter's Association Experiment Station.

James C. Marshall has been retained on the engineering staff of The M. W. Kellogg Co. Brig. Gen Marshall will help on new engineering and research projects included in the immediate program of the company.

Norman G. Sixt, previously with the McLaurin-Jones Co. and the Barrett Division of Allied Chemical and Dye Corp., has been appointed manager in charge of operations for the Susquehanna Chemical Corp. He will direct operations of the seven Susquehanna plants from the Bradford, Pa., office.

William J. Mueller, chemical engineer, has been named to the research staff of Battelle Institute, Columbus, and assigned to its division of organic chemistry. Mr. Mueller is a graduate of the University of Illinois. He was formerly associated with the U. S. Rubber Co., Charleston, W. Va.

Robert N. DuPuis, former assistant director, Miner Laboratories, Chicago, has joined S. C. Johnson & Son, Inc., as assistant research and development director.

K. W. Heise

George W. Heise, of National Carbon Co., Cleveland, has been elected president of The Electrochemical Society. **Colin G. Fink** was reelected secretary and **W. W. Winship,** of Thermal Syndicate, Ltd., remains as treasurer.

Melville F. Peters, formerly in charge of research at Titeflex, Inc., Newark, N. J., has been appointed chief engineer.

Otis Hutchins has retired as technical director of The Carbonundum Co. because of ill health and after 35 years with the company. Mr. Hutchins has been succeeded as technical director by **Harry C. Martin,** previously assistant technical director.

H. Douglas Tate has been appointed manager of agricultural chemicals development for United States Rubber Co. In his new position Dr. Tate will take charge of the rubber company's agricultural laboratories at Bethany, Conn., where research is conducted on new chemicals to destroy insects, plant diseases and weeds. He succeeds **George L. McNew,** who has resigned to become head of the department of botany at Iowa State College.

A. F. Langlykke who has headed the fermentation investigations of the Peoria Regional Laboratory has resigned.

Peter J. Massey, general manager of the Kalamazoo, Mich., mill of the St.

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Wet or Dry Grinding?

Abbé Pebble or Ball Mills grind and mix materials efficiently in batches or continuously, under normal conditions, high or low pressure or vacuum and temperature. Full range of capacities, mill linings, drives and grinding media.

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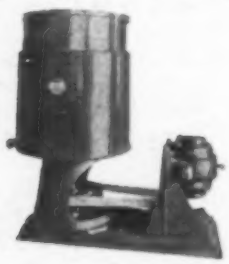

Abbé-Lenart Mixers completely disperse, grind, dissolve, blend and emulsify solids in liquids, reducing processing time as much as 75%. Handle thick or viscous materials; can operate under vacuum or pressure. Capacities ½ to 330 gallons.

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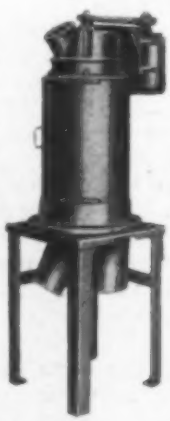

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Regis paper Co. was awarded the gold metal of the Technical Association of the Pulp and Paper Industry on February 27 for outstanding contribution to the technical advancement of the industry.

Harry K. Ihrig, director of laboratories of the Globe Steel Tubes Co., Milwaukee, received the Robert W. Hunt Medal on March 19 at the annual meeting of the American Institute of Mining and Metallurgical Engineers in New York.

Hugo Klein is now vice president in charge of production and research of Converted Rice, Inc., Houston, Tex.

E. Emerson Brott, formerly vice president and general manager of American-Marietta Co.'s Schorn division, Seattle, Wash., has been elected vice president of the parent company. He will be in charge of all Northwest operations.

Byron T. Shaw has been appointed assistant administrator in the Agricultural Research Administration, succeeding **W. V. Lambert** who was appointed administrator last October. Formerly Dr. Shaw was in charge of research on soils physics in the Bureau of Plant Industry.

John A. Hipple, authority on the design, construction, and use of the mass spectrometer, has been appointed chief of the atomic physics section at the National Bureau of Standards.

Leo I. Dana, manager of research for The Linde Air Products Co. and its associated units of Union Carbide and Carbon Corp., has been awarded the Jacob F. Schoellkopf Medal for 1947 by the Western New York Section of the American Chemical Society.

R. R. Sayers, director of the Bureau of Mines, left that position on March 31 to return to his former position as one of the research staff of the U. S. Public Health Service. The President has nominated his successor, **James Boyd**, who recently has been serving as dean of men, Colorado School of Mines.

James Irvin Hoffman of the National Bureau of Standards has been awarded the 1946 Hillebrand Prize for significant contributions to chemical science. The award was made by the Chemical Society of Washington at its annual dinner on March 13.

Frederick J. Bouchard has been appointed production superintendent at the cellulose products plant of Her-

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Fig. 645

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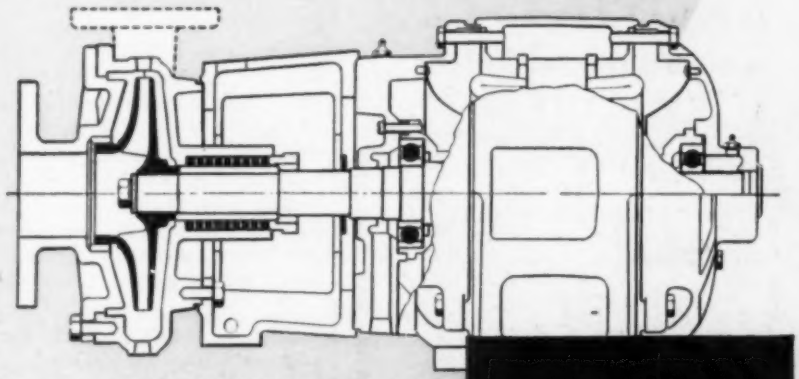
RIGID MOUNTING UNNECESSARY. Since the shaft is common to both pump and motor, positive alignment is assured; hence a rigid foundation is not required. Bilt-ons operate in any position from horizontal to vertical. A Bilt-on Pump is often mounted on a hand truck or suspended from a sling for portable use.

BIG PERFORMANCE. Bilt-on efficiencies are very high. Hydraulic performance is comparable to that obtained with double suction pumps of similar size. Bilt-ons are widely used in municipal, industrial and agricultural applications, pumping warm or cold liquids of every description: water, oil, gasoline, chemicals, etc.

RUGGED CONSTRUCTION. Two heavy, grease-packed ball bearings, mounted in motor-end bell housings, are enclosed to exclude dirt and water. Wide spacing of bearing centers plus heavy shaft permits overhanging the impeller without danger of shaft deflection. Standard Bilt-on stuffingbox with cage ring contains 7 packing rings; without cage ring it contains 9 packing rings. Steel water-jacketed stuffingbox or mechanical seals (single or double) can be supplied at additional cost.

WHERE LITTLE SPACE IS AVAILABLE



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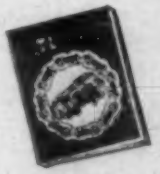

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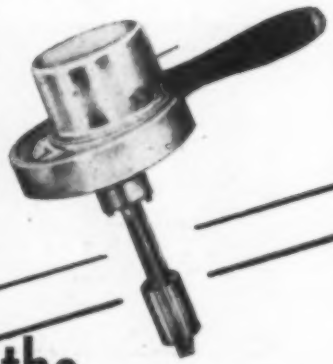

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Edward Hazlehurst has been appointed technical director of the Pantasote Co. Mr. Hazlehurst will make his headquarters at Passaic.

Jules Gilbert, associated with Westvaco Chlorine Products Corp. for the past five years and most recently a member of the Carteret plant engineering department, has been transferred to the technical service division with headquarters in New York.

Daniel C. Hall has recently been employed as a development engineer in the Calco Chemical Division of the American Cyanamid Co. at their titanium dioxide plant at Gloucester City, N. J. Mr. Hall has had several years experience in the pigment industry with New Jersey Zinc Co., Du Pont, Glidden Co. and Singmaster and Breyer.

Theodore C. Jensen has been appointed superintendent of paint and enamel manufacture and **Frank H. Russell** is superintendent of vehicle manufacture at the new Springdale, Pa., paint plant of the Pittsburgh Plate Glass Co.

H. H. Mottern, food research chemist, has been named director of research of H. J. Heinz Co.

Lawrence R. Hafstad has accepted appointment as director of the newly-created Johns Hopkins University Institute for Cooperative Research.

Felix E. Wormser has resigned as secretary and treasurer of the Lead Industries Association to accept an appointment as assistant to the president of the St. Joseph Lead Co. on May 12. Mr. Wormser was formerly on the editorial staff of *Engineering and Mining Journal.*

George J. Easter, formerly director of research with The Carborundum Co., has assumed added duties and responsibilities, having been appointed manager of research and development, with **Charles Wooddell** and **Garret Van-Nimwegen** as assistant managers.

Frederic L. Matthews has been appointed associate director of research of Monsanto Chemical Co.'s Merrimac division at Everett, Mass. Dr. Matthews' former post of coordinator of petroleum additives in Monsanto's organic chemicals division will be

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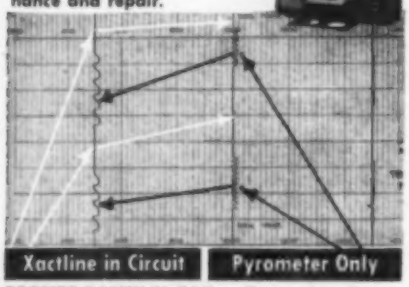

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filled by **Harry W. Faust**, at present a group leader in petroleum chemical research in the division. Mr. Faust's position will be filled by **J. F. Palmer**, research chemist in the petroleum chemical research group.

John A. Bolt has been appointed assistant superintendent of technical service in the research department of Standard Oil Co. (Indiana). Four group leaders have also been appointed in Standard's research department. They are **David W. Bransky, D. E. Bruce, T. B. Tom, and Lindsay M. Hobbs. John E. Swearingen**, group leader in the research department at Whiting, has been transfered to the Stanolind Oil and Gas Co. at Tulsa, Okla., and will be succeeded by **Carl W. Peters.**

John D. Coleman, of Dayton, Ohio, was elected president of the Ohio Society of Professional Engineers at their annual convention in Columbus, Ohio, March 21. Coleman, a chemical engineer with Frigidaire division, General Motors Corp., succeeds Allison C. Neff, Middletown.

Clayton Vogt recently accepted a position of development engineer with the soya products division of the Glidden Co. and is located in Chicago. He was formerly with Hercules Powder Co.

Wendell M. Stanley of the Rockefeller Institute for Medical Research, Princeton, N. J., Nobel prize winner in chemistry last year has been awarded the 1947 Willard Gibbs Medal of the Chicago Section of the American Chemical Society. He will receive the award at a meeting of the Chicago Section on May 23.

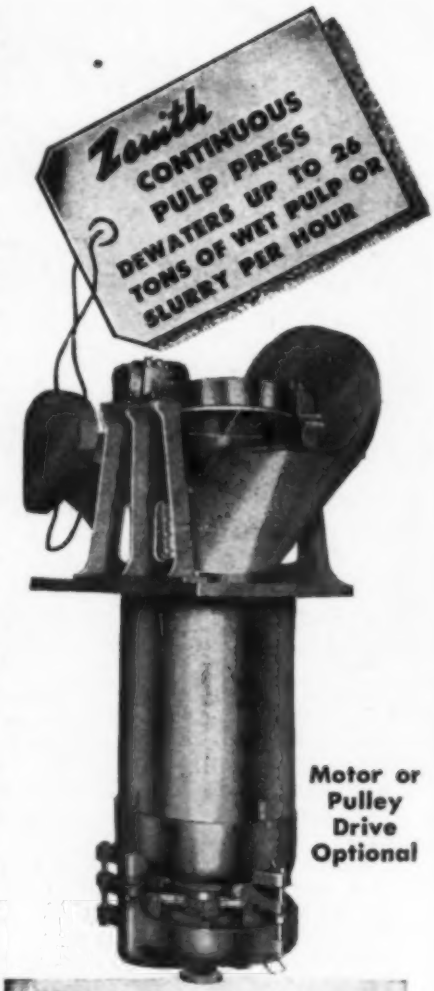
George H. Spencer-Strong, director of research of the Pemco Corp. since 1942, has been elected a vice president.

Randolph F. Harris has joined the Exton chemical division of Foote Mineral Co., Philadelphia, as chemical engineer.

E. L. Luaces, president and a director of Research and Development Corp., Dayton, has resigned to devote his time to private consulting practice in chemical engineering.

A. M. Finley has been appointed as development manager of Goodyear Tire & Rubber Co.'s mechanical goods plant in Lincoln, Neb.

Lloyd H. Wartman, Robert G. Bannister, John W. Brodhacker and Michael C. Shultz, research chemists,



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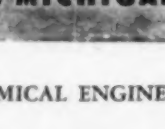

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Hydrogen sulphide won't burn until it is 2400° F., so Dresser had to devise a means of heating to 2400 a mammoth combustion chamber with natural gas then switch to sulphide. The newly developed Flomixer of Bryant Heater (Dresser member company) did the trick. By an ingenious adaptation, the whole system shifts from natural gas to burning hydrogen sulphide at the precise moment —using the same burner.

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have joined the research department of Commercial Solvents Corp. at Terre Haute.

A. S. Behrman, former vice president and chemical director, Infilco, Inc., and, following his return from active military duty in World War II, vice president and director of research, Velsicol Corp., has withdrawn from the latter organization and established a chemical consulting practice at 9 South Clinton St., Chicago.

W. L. Rippeteau recently joined the development department of Wyandotte Chemicals Corp. and will headquarter in Wyandotte, Mich. He will serve as a contact representative in connection with the new organic and inorganic products of the organization.

Warren K. Lewis, professor of chemical engineering, Massachusetts Institute of Technology, and **Carlton S. Proctor,** consulting engineer, received honorary degrees of doctor of engineering from Princeton University February 22.

C. P. Joslyn has been appointed to the newly created post of general manager of the Chemical Products Division of the Goodyear Tire & Rubber Co., Akron.

Henry G. Sellers, Jr., and **Glenn P. Wheeler** have joined the staff of Southern Research Institute, Birmingham, Ala.

Henry F. Palmer is now engaged in private practice as a consultant serving the rubber and chemical industry. His headquarters are at 715 West Market St., Akron. Dr. Palmer resigned last fall from Firestone Tire & Rubber Co. after 21 years of service.

Vernon A. Breitenbach has been awarded the $1,200 Pfaudler Fellowship in Chemical Engineering for the current year by the University of Rochester.

Daniel B. Leyerle is now beverage control chemist in the central laboratory of the Great Atlantic and Pacific Tea Co. in New York. He was formerly with the Borden Co.

Frederick H. Vogel, wood technologist, has joined the laboratory staff of the Timber Engineering Co.

George C. Smullen has joined the staff of the Casein Co. of America, division of the Borden Co. He was formerly with Benjamin Moore & Co., Sherwin-Williams Co., and for the

● Abrasion, gouges and other scars of long useful service do not affect HAVEG'S high resistance to a long list of corrosive agents.

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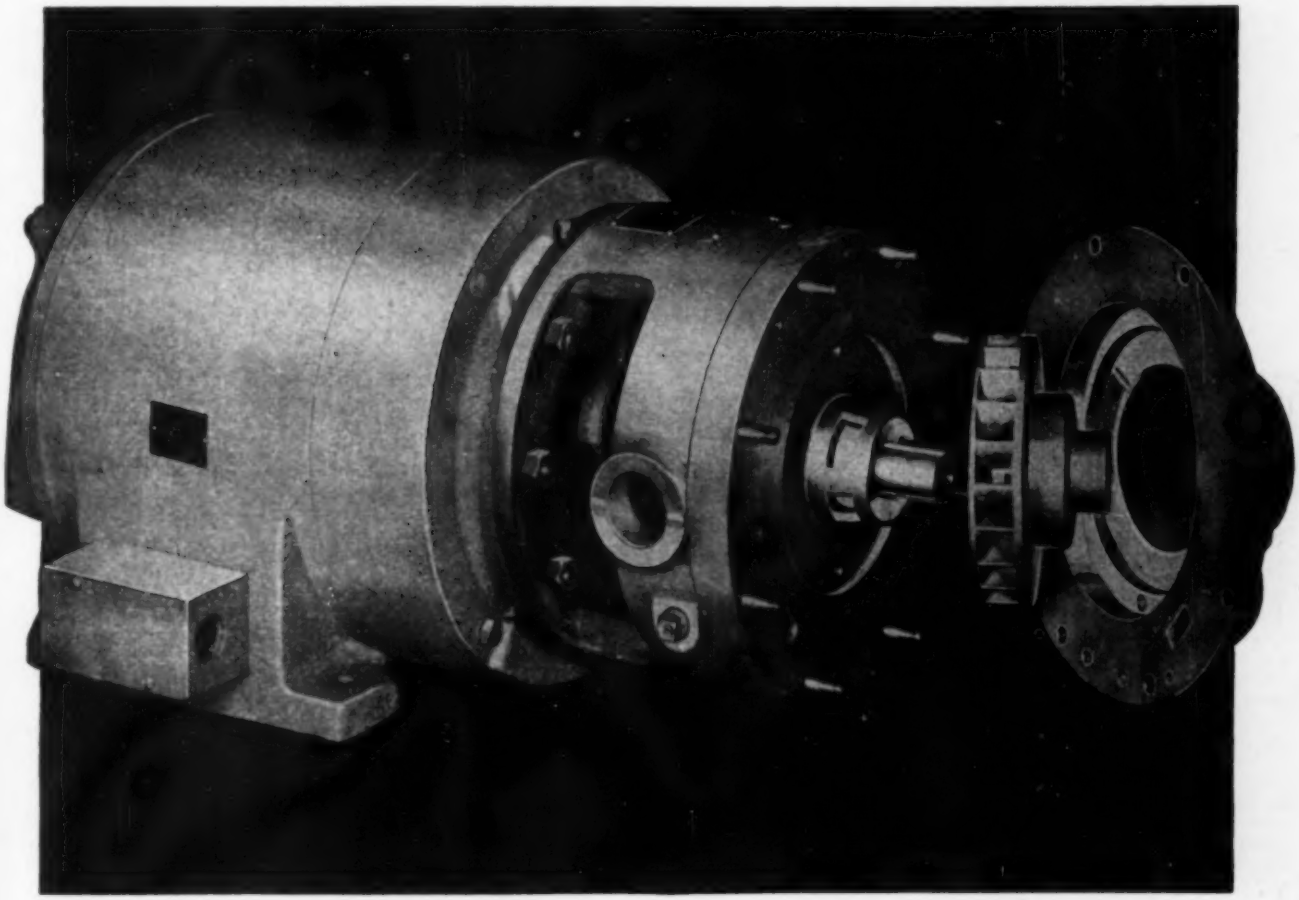
The Nash Clean-Air Compressor has but one simple moving part.



The Nash Clean-Air Compressor has but one moving part, cast in one piece and rotating in the pump casing without metallic contact. No internal lubrication is necessary; therefore air or other gas compressed with a Nash is entirely free from oil contamination.

Dust and heat are removed from the air, or gas compressed, by the unique Nash "Liquid Piston". Air from a Nash Compressor is therefore delivered free from dust, heat, or oil, without supplementary filters or air washers, in a perfected mechanical structure with no internal wearing parts.

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Bulletin D-252 tells all about Nash Clean-Air Compressors, and it is free on request.

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Louisiana with her wide diversification of industries, thriving cities and vast areas of irrigated rice lands has in use more than six hundred and thirty Layne Well Water Systems. These skillfully engineered and precision built systems—equipped with the famous Layne high efficiency Vertical Turbine Pumps, are producing many hundred millions of gallons of water daily at an amazingly low cost.

Throughout the entire state of Louisiana, Layne Well Water Systems far outnumber all other kinds combined . . . . proving by actual use that Layne equipment is definitely superior in high efficiency, rugged quality, and long life.

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Wells—Lakes—Rivers—Reservoirs—Irrigation Projects—are obtainable in sizes from 40 to 16,000 gallons per minute, powered by electric motor, V-belt or angle gear drives. Write for Pump Catalog.

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AFFILIATED COMPANIES: Layne-Arkansas Co., Stuttgart, Ark. • Layne-Atlantic Co., Norfolk, Va. • Layne-Central Co., Memphis, Tenn. • Layne-Northern Co., Mishawaka, Ind. • Layne-Louisiana Co., Lake Charles, La. • Louisiana Well Co., Monroe, La. • Layne-New York Co., New York City • Layne-Northwest Co., Milwaukee, Wis. • Layne-Ohio Co., Columbus, Ohio • Layne-Pacific, Inc., Seattle, Wash. • Layne-Texas Co., Houston, Texas • Layne-Western Co., Kansas City, Mo. • Layne-Western Co. of Minn., Minneapolis, Minn. • International Water Supply Ltd., London, Ont., Can. • Layne-Hispano Americana, S. A., Mexico, D. F.

past ten years served as assistant to the president of the Muralo Co., Inc. During the war Mr. Smullen headed the Paint, Varnish and Lacquer Unit of the War Production Board.

William M. Potts of the Agricultural and Mechanical College of Texas, has been elected chairman of the Texas A. & M. Section of the American Chemical Society. He succeeds **Francis F. Bishop**, professor of chemical engineering at A. & M.

A. E. H. Houk has been named head of the nutrition laboratory of H. J. Heinz Co., with headquarters in Pittsburgh.

John H. Boyd, formerly of Richmond, Va., has been appointed district manager in charge of the branch office of the Lebanon Steel Foundry Co. in Atlanta, Ga.

OBITUARIES

Eric C. Gyllensvard, export and New York office manager of Farrel-Birmingham Co., was killed by lightning in Sao Paulo, Brazil, February 17.

John H. Allen, 89, founder and president of Everlasting Valve Co., Jersey City, died at his home in Orange, N. J., February 18.

Henry L. Randall, president of the Riverside Metal Co. for over 40 years, died in Riverside, N. J., February 18.

Hugh A. Galt, 79, after a distinguished career in American chemical industry, died at his home in Ventnor, N. J., February 24.

Charles S. Rowe, 54, sales manager of the fine chemicals division of the Du Pont company's organic chemicals department, died in Wilmington March 1.

Frederic Vieweg, 59, director of the American Potash & Chemical Corp., who recently resigned as president, died in Los Angeles March 3.

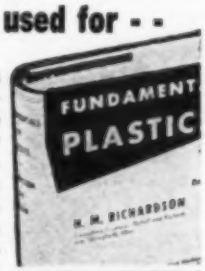
Walter S. Paine, manager of the engineering and inspection division of the Ætna Life Affiliated Cos., died at the Hartford Hospital March 8.

William M. Wentz, 45, a member of the technical laboratory staff of the Du Pont company's organic chemicals department, died in Worcester, Mass., March 13.

Roy Cross, chairman of the board of governors and one of the founders of the Midwest Research Institute, died suddenly March 21.

What plastics are made of--
How they are manufactured and applied - -
What they are used for - -

This reliable handbook supplies men in the plastics industry with the basic information they need on plastic technology. Experts in each phase of the plastic industry present: fundamentals regarding the relationship of chemical structure to physical properties; the major classes of plastics; commercial methods used in the manufacture of plastic products; an evaluation of plastics, including their measurement and manufacturing control.



Supplies complete information on:
- the chemical structure of plastics
- their six classes
- commercial methods of manufacture
- testing methods and quality control

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483 pages, 5½ x 8¼, 194 figures, 59 tables, $5.00

Let this new book supply you with a highly reliable and useful presentation of the basic elements of plastics—brought to you by experts in each phase of plastics development. The fundamentals that are necessary for a thorough comprehension of the nature, manufacture, application and uses of plastic materials and products are presented in careful detail, providing a firm basis for all specialization in the field. Hundreds of photographs, drawings, diagrams, charts, and tables are included.

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- Properties and Application of Plastics
- Thermosetting Resinous Condensation Products
- Thermoplastic Cellulosic Plastics
- Vinyl Polymers and Related Resins
- Rubber and the Synthetic Elastomers
- Polyesters and Polyamides
- Cross-linked Addition Polymers
- Silicone Resins, Rubbers and Related Products
- Plastics Product Design
- Molds for Plastics
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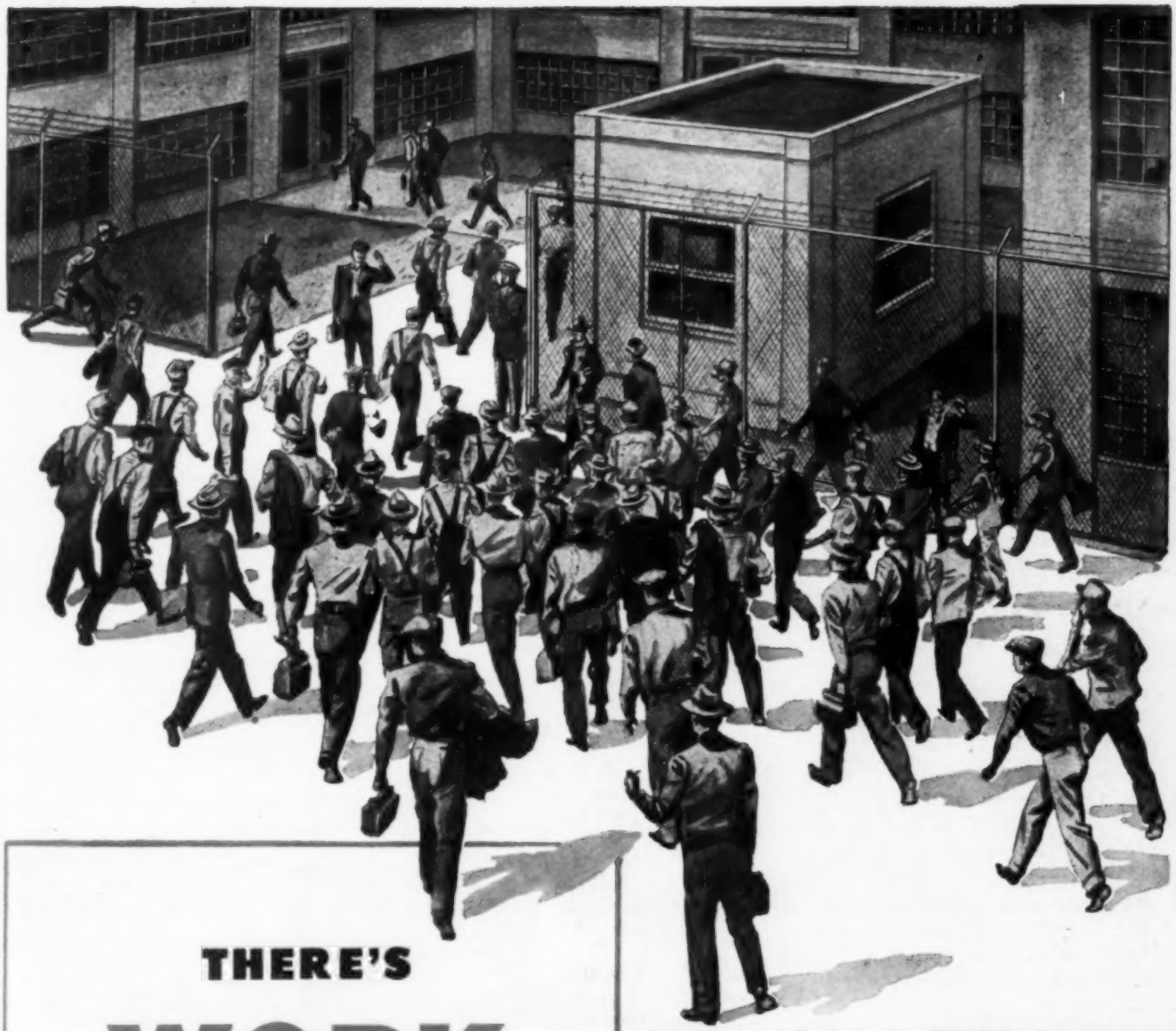

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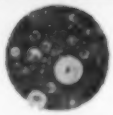

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INDUSTRIAL NOTES

Dorr Co., New York, has sold its interest in the Electro Rust-Proofing Corp. to Wallace & Tiernan Co.

Askania Regulator Co., Chicago, has moved to new quarters at 240 East Ontario St.

Witco Chemical Co., New York, is constructing a stearate manufacturing unit at its plant in Chicago. Operations are expected to begin May 1st.

Bradley Paint Engineers, Inc., Pittsburgh, Pa., is the name of a new firm. Sales and consulting offices are in the Jones Law Bldg., Pittsburgh, and the manufacturing plant is at Connellsville, Pa.

Hewitt-Robins, Inc., New York, has consolidated the Birmingham office of the Robins Conveyors division and the Hewitt-Rubber division. The new office is at 615 North 9th St.

Owens-Illinois Glass Co., Toledo, has announced that the Kimble Glass Co., will hereafter be operated as the Kimble Glass Division of the Owens-Illinois Glass Co. The subsidiary corporation has been liquidated. The present management will remain in charge.

Davison Chemical Corp., Baltimore, Md., has acquired the Cincinnati plant of the Diakel Corp., Paddock Road, Bond Hill.

Hagan Corp., Pittsburgh, has purchased the Ring-Balance Instrument Co. of Chicago.

G & W Plating Co., New York, is the name of a new firm formed by Norman I. Ginsberg and John O. Walsh. The plant is located at 1357 Seneca Ave., Bronx, N. Y.

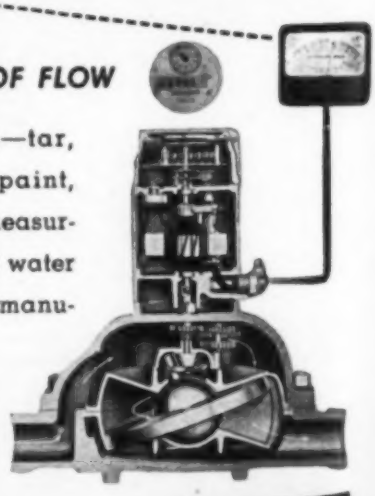
Spencer Chemical Co., Kansas City, Mo., recently promoted John R. Riley, Jr., to general sales manager. J. Richard Adams is now chief of the technical division. H. R. Dinges recently joined the company as sales manager of its chemical division.

Bath Iron Works Corp., Bath, Maine, has purchased all the outstanding stock of Pennsylvania Crusher Co., Philadelphia, Pa. New officers elected are W. S. Newell, president; J. Wm. Schulze, vice president and treasurer; A. H. Kretschmer, secretary and assist-

NEW **HAYS Veriflow TOTALIZING-INDICATING METER**

Featuring

REMOTE INDICATION OF RATE OF FLOW



For practically all liquids—tar, molasses, crude oil, grease, paint, varnish, syrups, etc., etc.—for measuring, indicating, totalizing flow of water and chemicals in continuous manufacturing processes and numerous other uses. Its remote indicating feature is new—get the complete story.

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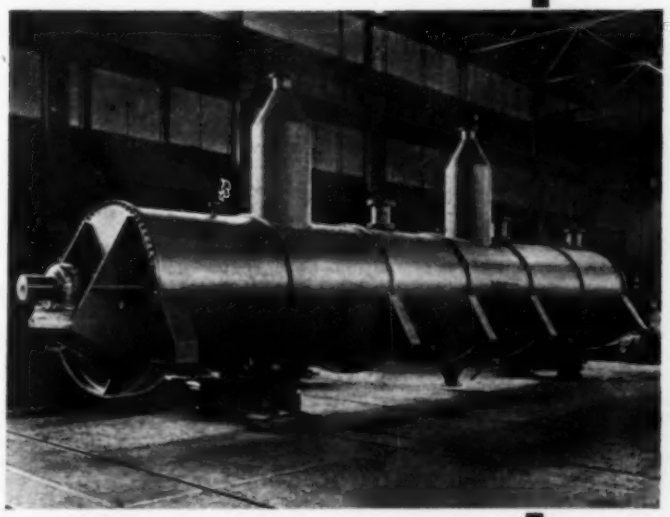
MICHIGAN CITY, INDIANA, U.S.A.

Stainless Steel PROTECTION with Clad Steel ECONOMY



Rotary vacuum drier fabricated of a Lukens Clad Steel. The drier, for use in a chemical plant, was built by Blaw-Knox Division of Blaw-Knox Company, Pittsburgh, Pa. It measures 36' 0" long by 5' 6" O.D.

You can save money on equipment requiring the corrosion resistance and product protection of stainless steel by use of economical Lukens Stainless-Clad Steels. Other advantages include:

- ★ **Cladding available in any standard specification of stainless steel, including types 304, 316, 347, 410 and 430.**
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- ★ **Plates from 3/16" to over 3" thick, or up to 162" wide. It is always cheapest to fabricate the widest plate usable.**
- ★ **Flanged and dished heads of all styles and sizes up to over 18' in diameter. Lukens has specialized in forming heads for over 55 years.**
- ★ **Backed by over 17 years' experience in the production of clad steels, starting with Lukens Nickel-Clad Steel, and now also including Inconel-Clad, Monel-Clad and Stainless-Clad Steels.**

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Please write for our Bulletin 338, "Lukens Stainless-Clad Steels." Another Bulletin, 255, "Lukens Nickel-Clad, Inconel-Clad, Monel-Clad Steels," is also available.

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World's Largest Plate Mill

Divisions: By-Products Steel Corporation • Lukenweld, Inc.

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STEELS

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A wisp of smoke from a faintly smoldering fire is all it takes to operate a C-O-Two Smoke Detector. The Detector sniffs air ***continually*** *from all protected areas. If smoke is present, an alarm sounds and, like a tiger, a C-O-Two fire extinguishing system springs into action; the fire is smothered in seconds with a cloud of cold, dry, inert carbon dioxide gas. A few minutes later the area is ready for use again; no after-fire clean-up is necessary. Carbon dioxide won't harm finishes, fabrics or equipment. It is a non-conductor and can be used safely on live electric equipment. Snuffs out flammable liquid fires.*

Investigate this new and modern method of detecting and extinguishing fire at its start. C-O-Two Smoke Detectors are not dependent on heat for operation. They are especially designed for fast detection of slow smoldering fires in record vaults and storage spaces.

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Sales and Service in the Principal Cities of United States and Canada

AFFILIATED WITH PYRENE MANUFACTURING COMPANY

ant treasurer and S. D. Hartshorn, acting general manager. Sales and engineering offices will be continued in Philadelphia.

Wyandotte Chemicals Corp., Wyandotte, Mich., has announced that the Michigan Alkali and J. B. Ford divisions of the corporation now occupy offices in the Henry W. Oliver Bldg., Pittsburgh, Pa.

Commercial Solvents Corp., New York, has assigned William J. Exum to the sales department of the new Dixie chemical division. He will be located in the New York office. Raymond J. Schraff is now with the Cleveland office and John R. Post is located in the Chicago office.

Davison Chemical Corp., Baltimore, Md., has appointed William Caspari general sales manager of the phosphate rock division, Bartow, Fla.

Fritzsche Brothers, Inc., New York, has elected the following members to the board of directors: Dr. Ernest Guenther, B. F. Zimmer, Jr., and Fred H. Leonhardt. Dr. Darrell Althausen is now manager of the Clifton, N. J., plant.

Cornell Machine Co., New York, has appointed A. N. Bowes to the post of manager, process industries division, and has named J. Albert Post, Jr., manager of the petroleum process division.

E. I. du Pont de Nemours & Co., Wilmington, Del., has appointed Frank G. Keenen assistant sales manager of the nitrogen products section sales division of the company's ammonia department.

Pittsburgh Plate Glass Co., Pittsburgh, Pa., has appointed Martin G. Levens sales representative in Cleveland, Ohio, for the Columbia chemical division.

Monsanto Chemical Co., St. Louis, Mo., has elected Frederick M. Eaton to the board of directors.

Liquid Conditioning Corp., Linden, N. J., has named L. S. Luther & Co., engineering sales and service representatives in the District of Columbia, Virginia and Maryland. Washington headquarters are at 1018 Eighteenth St., N. W.

Clark Mfg. Co., Cleveland, Ohio, elected William P. Webster to the board of directors.

Wilbur and Williams Co., Boston, Mass., announced the appointment of

WILFLEY is the highly efficient pump that delivers continuous 'round the clock performance for months on end WITHOUT ATTENTION . . . Famous for dependability, WILFLEY pumps embody many exclusive features developed through years of pioneering and research in the field. Heavy pumping parts of rubber, alloy iron, alloy steel—whatever material best suits your particular problem. Individual engineering on every application. Buy WILFLEY for high efficiency and cost saving performance. *Write or wire for details.*

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NEW YORK OFFICE: 1775 Broadway, New York City

Stainless steel condenser 2'0" inside diameter — 17'6" long.

Fractionating columns complete with bubble trays and caps. (Steel 5'6" dia. x 120' long)

14" silicon bronze refinery piping, with steel back-up flanges.

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Nooter Engineering Fabrication Goes Beyond Structural Exactness

Nooter's advanced, complete facilities for processing equipment fabrication—plus more than fifty years experience and generations of skilled craftsmen assure you of more than exact compliance to your specifications. Over and beyond this, Nooter engineers with their technical knowledge of metal properties and behaviors make certain that your equipment will be of utmost functional efficiency as well as structurally perfect.

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Send for your copy of corrosion resistant metal tables—just off the press.

NOOTER ST. LOUIS

JOHN NOOTER Boiler Works Co. • 1424 S. Second St., St. Louis 4, Mo.

John Wild as manager of the chemical resistant coating division.

Duriron Co., Inc., Dayton, Ohio, has elected Robert C. Schenck president. William E. Hall, former president, has become chairman of the board.

E. I. du Pont de Nemours and Co., Wilmington, Del., has promoted David E. Goldich, assistant manager of the Chicago region in the finishes division, to the managership to succeed Guy A. Biesecker.

Goodyear Tire & Rubber Co., Akron, Ohio, has appointed C. P. Joslyn to the newly created post of general manager of the chemical products division.

United States Stoneware Co., Akron, Ohio, has added Sidney A. Lewis to the process equipment division sales engineer force in the New York office.

Yale & Towne Mfg. Co., New York, has arranged to borrow $10 million to provide for additional working capital and for plant expansion. Metropolitan Life Insurance Co. and Mutual Life Insurance Co., of New York are financing the loan. A contract has been awarded to the Turner Construction Co., for the erection of a new, 16 acre Philadelphia plant to replace the present unit in that city.

Non Ferrous Foundries, Inc., Indianapolis, Ind., has installed facilities for the production of special castings made under a license arrangement with P. R. Mallory Co., Inc.

A. R. D. Corp., New York, has moved to enlarged quarters at 157 Chambers St.

Hammond Iron Works, Warren, Pa., has acquired complete manufacturing facilities at Port Neches, Tex.

B. F. Goodrich Co., Akron, Ohio, has appointed Robert B. Wetsel manager of anode sales.

Phenoglaze Sales Corp., New York, has appointed Harley Williams sales manager.

Titan Metal Manufacturing Co., Bellefonte, Pa., has appointed Paul R. Spencer Co., 4000 York St., Denver, sales agent for the district including Montana, Nebraska, Arizona, New Mexico and West Texas and Colorado. The Tulsa office has moved to 1348 South Indianapolis St.

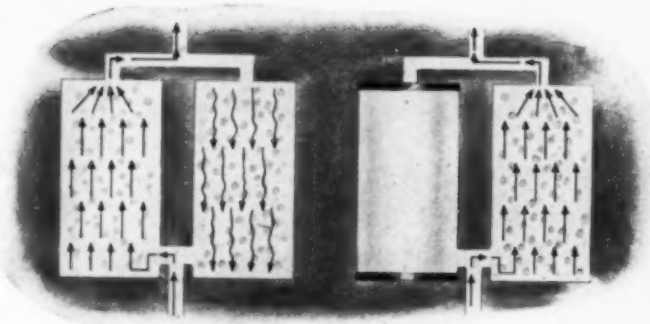
Jenkins Bros., Bridgeport, Conn., has elected Alfred J. Yardley president. He succeeds his father who becomes chair-

here's why we say,

"send Lectrodryer* your DRYing problems"

Of course, anybody can design a dryer

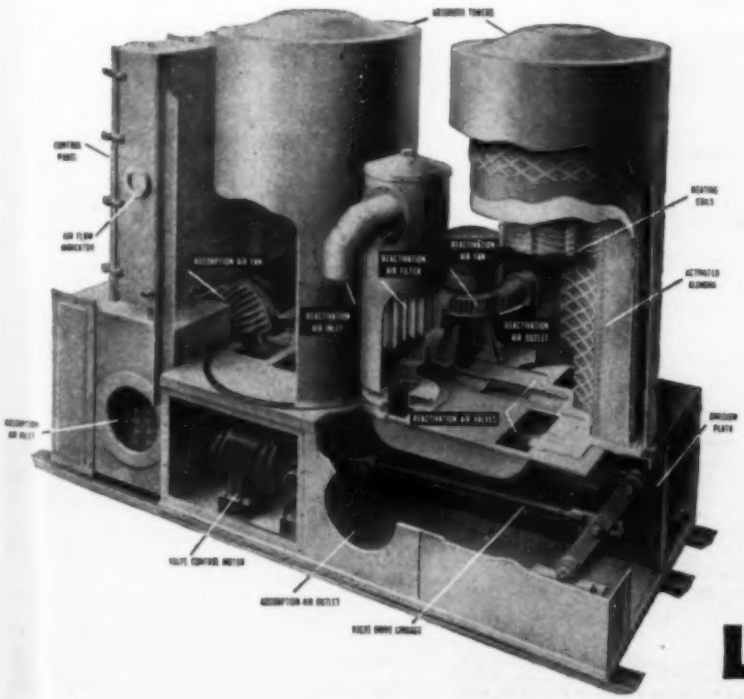
The principle's simple: Pass the wet air, gas or organic liquid through a drying agent. When that column has picked up a healthy charge of moisture, pass it through the second column while you regenerate the first with heat.



Its many elements combine to make Lectrodryer a safe, dependable, efficient DRYing machine.

But DRYing needs a lot of know-how

"What materials can we dry? In what volumes and at what speeds? What DRYness should we aim for? What adsorbent should we use and in what quantity?" And so on—



Lectrodryer has that know-how, based on many years of solving DRYing problems for many industries. And there's usually a standard Lectrodryer ready to handle the job. No need for your engineers to take valuable time figuring out unfamiliar drying tasks.

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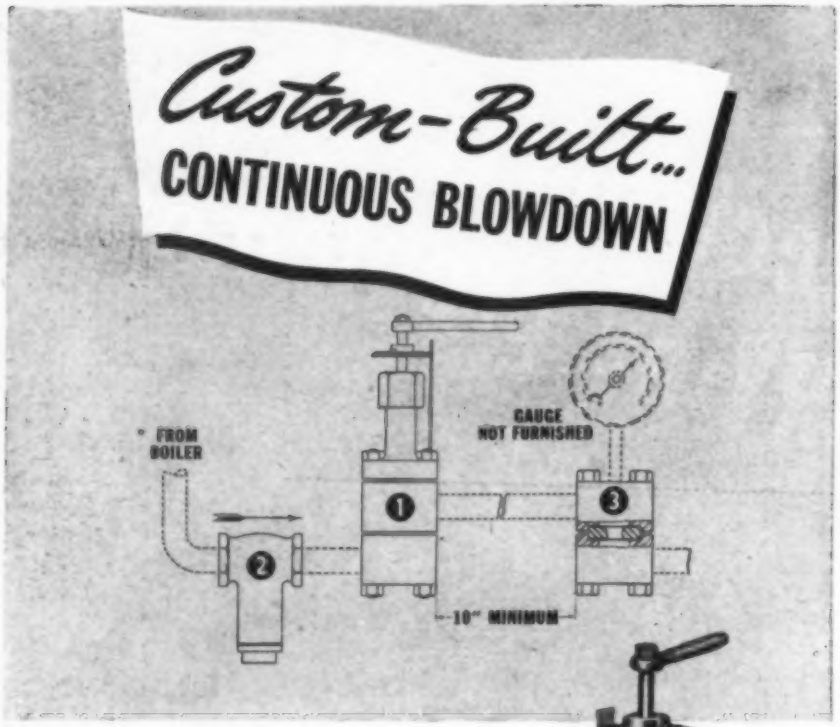
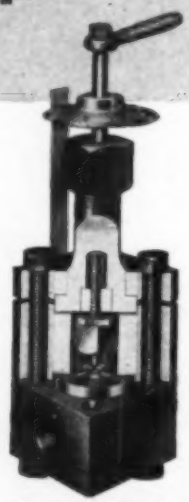


STRONG Dual-Orifice Assembly gives Greater Accuracy . . . Rugged Service!

Strong's Continuous Boiler Blowdown Assembly includes a Strong *block steel* Evrtyte* Valve (1), a strainer (2) and an orifice block (3), *custom-built* and accurately sized for *your own job conditions.*

The assembly is essentially two orifices arranged in series. The first orifice (valve) is variable . . . . the second is fixed. Correct proportioning of orifices provides extremely accurate control and reduces wire drawing.



Also available in outside screw and yoke.

Strong Evrtyte steel valves have special Anum-Metl X† seats and discs of 750 Brinell surface hardness for long life. Available for pressures to 1500 psi and temperatures to 800° F. or 6000 psi non-shock cold service.

Let us custom-size your continuous blowdown system. Send for Catalog No. 102 and our Continuous Blowdown Check-Chart today!

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STRONG, CARLISLE & HAMMOND COMPANY

1392 West 3rd Street
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† Anum-Metl Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES

Reducing Valve | No. 80 Series Trap | Strainer

STRONG

man of the board. James L. Dunn, vice president in charge of industrial relations, and C. C. Chamberlain, general sales manager, have been elected to the board of directors.

Shawinigan Chemicals Ltd., Montreal, Quebec, announced that H. S. Sutherland, formerly general sales manager, has been appointed vice president in charge of sales.

Minneapolis-Honeywell Regulator Co., Minneapolis, and its industrial division, Brown Instrument Co., have opened a district office at 27 Halstead St., East Orange, N. J. The new site will operate under New York branch office direction.

American Chemical Paint Co., Ambler, Pa., has awarded a contract to the Gustave T. Reich firm for the construction of a cholesterol plant.

Liquid Conditioning Corp., Linden, N. J., has moved its main office and plant to Linden, N. J.

American-Marietta Co., Chicago., has appointed T. R. Johnson general manager of the Keystone asphalt products division. Lib Panichi has been promoted to production manager at the Keystone plant in Chicago Heights.

Pittsburgh Plate Glass Co., Pittsburgh, Pa., elected Donald C. Burnham and John A. Wilson to newly created vice presidencies. Richard B. Tucker was elected executive vice president.

Wheelco Instruments Co., Chicago, Ill., has appointed E. W. Heffernan manager of the new Philadelphia Sales and Service office at 424 West Olney Ave.

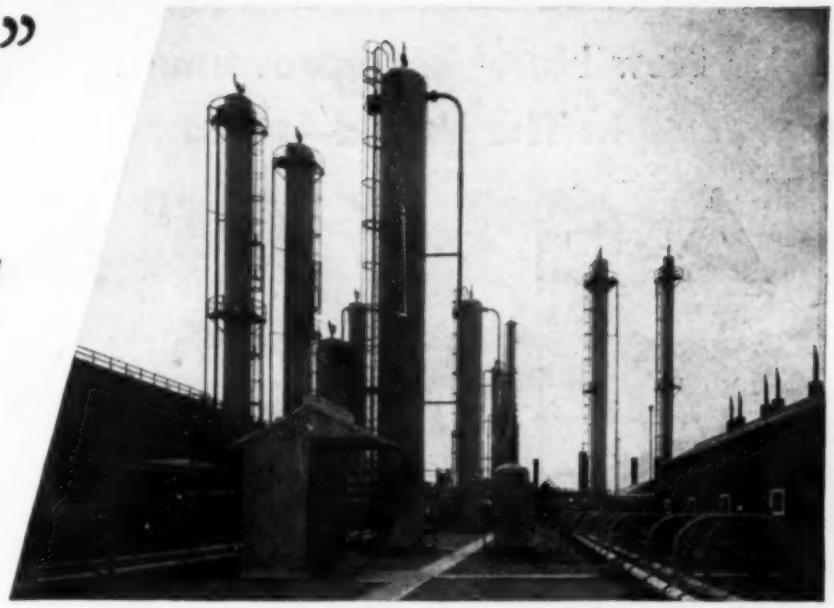
Allis-Chalmers, Milwaukee, Wis., has named Philip Chen factory representative in Shanghai for the general machinery division export department.

American Machine & Foundry Co., New York, appointed Herbert C. Johnson sales representative. His territory will include New Jersey, Pennsylvania, West Virginia, Maryland, Delaware, and Virginia.

Diamond Alkali Co., Pittsburgh, Pa., elected Fred W. Fraley a director of the company. He is vice president in charge of sales.

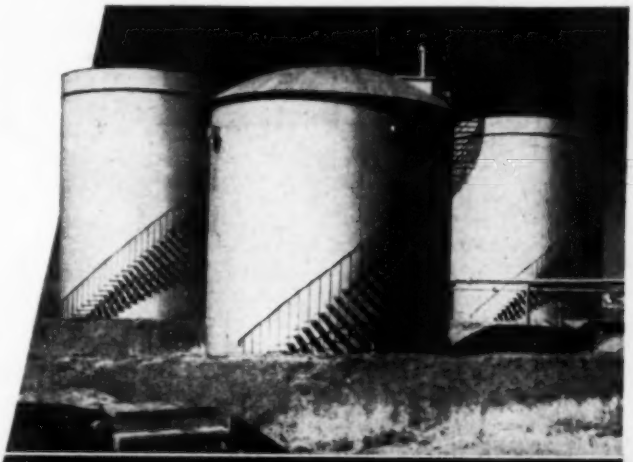
Gaston Johnston Co., New York, has been appointed general representative and sales agent in the United States and Canada for the Chemical Industries of Noock Domajo Aktiebolag,

"teamwork" with American Industry



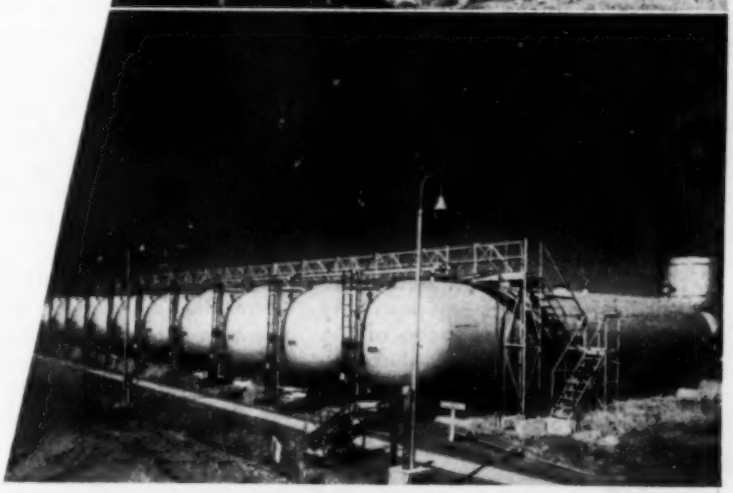
Our fabricating plants are working with industry daily—turning out shop-built and field-erected structures like those shown on this page. This kind of "teamwork" with industry is enabling chemical and process plants to make *better* finished products for consumers and *more* new materials for use by other manufacturers.

. . . working with a Texas cycling plant and a chemical plant



★ The refinery towers and pressure drums shown above ★ were built at one of our plants for the La Gloria Corporation cycling unit near Falfurrias, Texas. They include a 4-ft. diam. by 102-ft. low pressure reabsorber, 10-ft. diam. by 57-ft. still and rectifier, 7-ft. diam. by 98-ft. 6-in. debutanizer, 5-ft. 6-in. diam. by 95-ft. 6-in. depropanizer and oil tanks, surge tanks and feed and reflux tanks used in the process unit.

The two photos at the right show some of the storage facilities at the Celanese Corporation's Bishop plant. The tanks in the upper picture are for acetone storage. The one in the foreground, of 2,000-bbl. capacity, has a floating roof and an umbrella to keep out the weather. The two in the background hold 5,000 bbls. each and are also equipped with floating roofs. The lower picture shows a group of ten cylindrical tanks with hemispherical ends. They are used to store butane.



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Stockholm, Sweden. Mr. Johnston's office is at 865 First Ave., New York.

American Brake Shoe Co., New York, has appointed Emmett A. Williams vice president in charge of operations, and I. E. Cox vice president in charge of engineering of the national bearing division.

Skinner Chuck Co., New Britain, Conn., purchased all physical assets of Allied Control Valve Co., Inc., South Norwalk, Conn. This company is now known as Allied Control Valve Division, Skinner Chuck Co.

Columbia Rubber Co., Ravenna, Ohio, has appointed Robert L. Schroy to direct sales activities.

E. I. du Pont de Nemours & Co., Wilmington, Del., has appointed L. H. Priday as manager of the Parlin, N. J., plant of the finishes division. H. L. Priddy was named assistant manager of the Parlin plant and Norman I. Dress has become assistant manager of the Chicago plant.

Standard Oil Co. (Indiana), Whiting, has promoted L. H. Butterworth to assistant general superintendent of the company's Casper, Wyo., refinery.

Automatic Transportation Co., Chicago, has named Herbert B. Cumming, Inc., northeastern New Jersey sales representative. Service headquarters are located in Rochelle Park, N. J.

Rogers Corp., Goodyear, Conn., has appointed Joseph M. Lurie to the post of technical director.

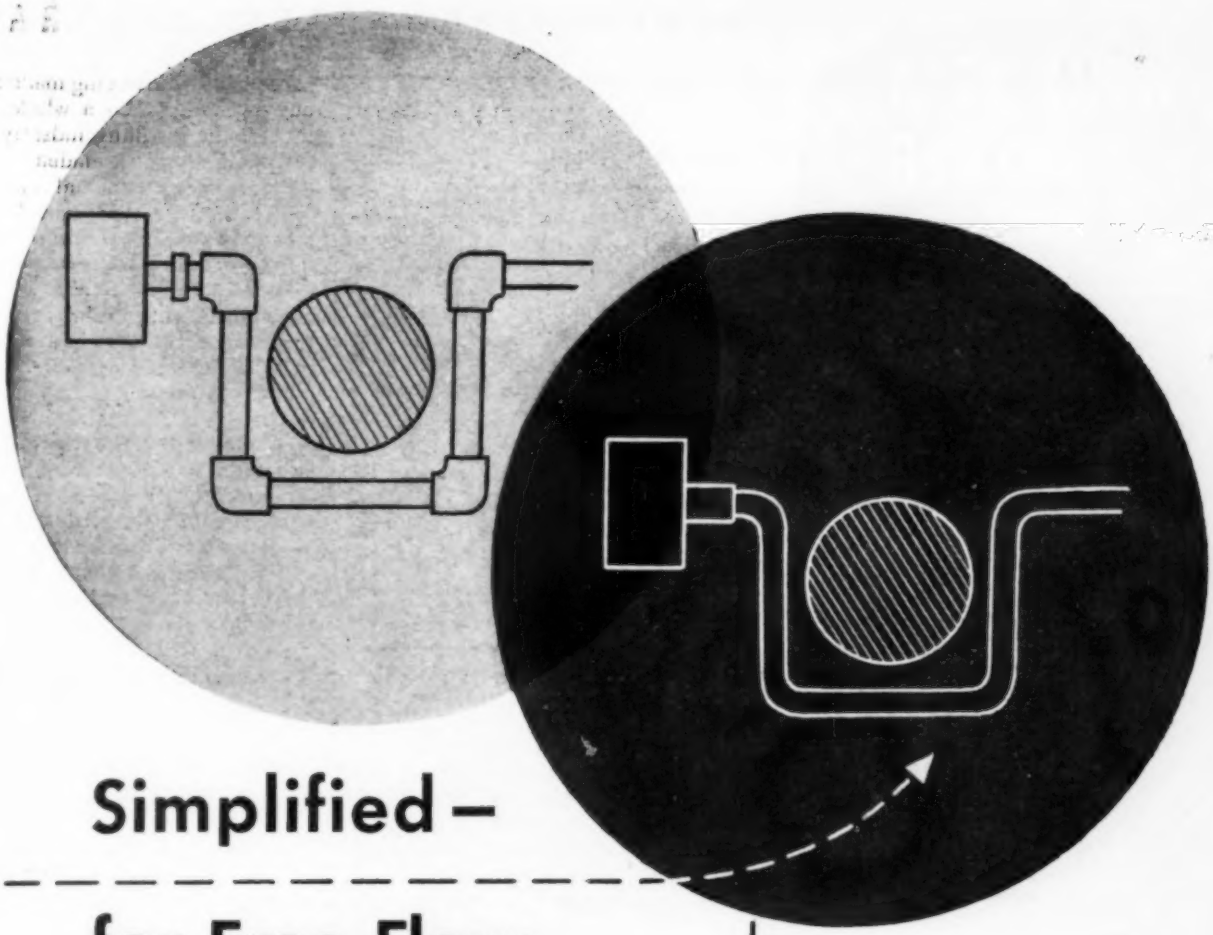
Adolph I. Buehler, Chicago, has been appointed exclusive agent for Amsler Testing Equipment in United States and Canada.

Lincoln Electric Co., Cleveland, Ohio, has named Wallner Welding Supply Co., 303 South First Avenue, East Duluth as their dealer in Duluth.

H. K. Porter Co., Inc., Pittsburgh, has elected Col. G. deFreest Larner director of the company.

Goodyear Tire & Rubber Co., Akron, Ohio, has added three men to the Pliofilm field sales force. P. N. Dexter, Boston, Mass., Thoralf Magnusun, New York, and Willy Boudry, Los Angeles, will handle general sales work in their respective territories.

All-State Welding Alloys Co., Inc., has opened an export office at 21 State St., New York with J. V. Cremonin as manager.



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Easy to bend, tubing goes wherever you want it—around corners—into tight places . . . with *fewer fittings*—fewer chances for leakage. Assembly and maintenance are quicker—easier.

Tubing systems, engineered with PARKER Fittings and Valves, insure Free Flow, with fewer obstructions and less turbulence. They take less space—and weigh less.

If you have fluids to move—either liquids or gases . . . under high or low pressure—you can do it better using tubing with PARKER Fittings and Valves. Available from conveniently located warehouses and distributors.

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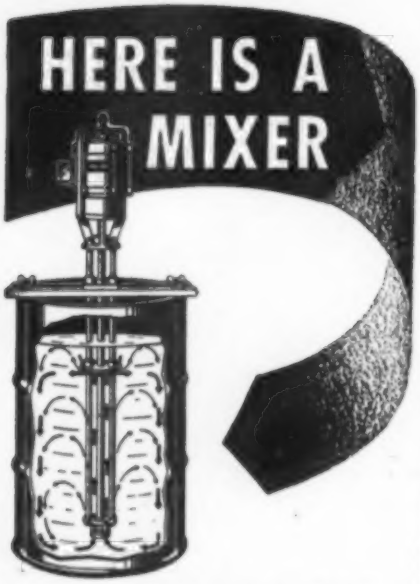
All PARKER Fittings are *precision-made*—easy to install or remove, and every PARKER Fitting is a *coupling*.

Write for Bulletin A-48, reviewing PARKER Products.



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Cut shows a 1 HP Eppenbach Homo-Mixer processing entire contents of open-end 55 gallon drum at 7,000 RPM without vibration or splashing.

Mixing tank requires no cover because this mixer will not produce a vortex or other excessive turbulence on the surface.

Units designed up to 25 HP for mixing all types of free-flowing liquids.

The Eppenbach Homo-Mixer is unlike any known batch mixing device. The design permits far higher speeds than are practicable with any propeller or blade-type agitator. Proportional increase in hourly capacity may be easily attained, together with qualitative improvement of resulting mixture.

If you are not already familiar with this unique portable agitator, write for a copy of Catalog No. 402. No cost, no obligation.

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CONVENTION PAPER ABSTRACTS

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Distillery Byproducts

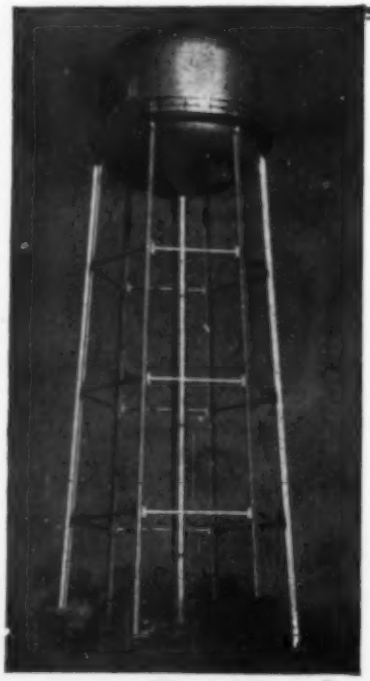
ALTHOUGH the distilling industry is one of the oldest known to man, it is a late comer in the field of scientific development because of its non-existence during a period when science and technology were practically revolutionizing industry. Tremendous strides have been and are being made throughout out industry as a whole, and although the distilling industry was off to a slow start, it is gradually catching up, both industrially and scientifically.

Whisky may eventually be considered a byproduct of the distilling industry instead of its major product, because of the results of feeding experiments with "solubles" from distillery wastes. Formerly discarded, the solubles are now recovered from the liquid byproduct by evaporation and drying. Fed to dairy and beef cattle, hogs and poultry, the results have been so startling that the former waste is now recovered, processed and sold. Approximately 30 percent of the grain processed in a distillery is recovered as feed, and research has proved that this 30 percent is much greater in feed value than the original grain.

J. W. Spanyer, Jr., Brown-Forman Distillers Corp., before American Institute of Chemical Engineers, Louisville, Feb. 17, 1947.

Continuous Process for Grease Production

A NEW, better and continuous way of making greases eliminates the batch method of the past which involved the



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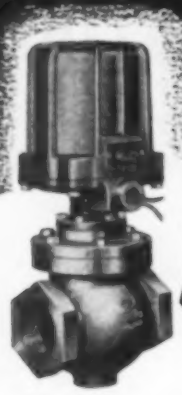
Explosion Proof

TO PROVIDE SAFE CONTROL IN "HAZARDOUS LOCATIONS"



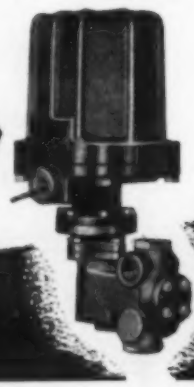
Bulletin 8211—Type EP-PFZ Explosion-Proof Packless Shut-off Valve.

Class 1, Group D Hazardous Locations are defined as "atmospheres containing gasoline, petroleum, naphtha, alcohols, acetone, lacquer solvent vapors and natural gas."

Don't let the existence of such atmospheres in your plant bar you from making good use of solenoid valves for controlling automatically the flow of liquid or gas. Our Explosion-Proof Solenoids are thoroughly safe and approved by Underwriters' Laboratories. Many years of service in oil refineries, gas manufacturing plants and chemical plants have demonstrated not only the efficiency but reliability and safety of ASCO Explosion-Proof Valves in the above hazardous locations.

Look over your plant and flowsheet. If there is any place where conditions are hazardous and where you would want the flow of any liquid or gas to automatically cease—or start—should anything go wrong, or if you want to have automatic cyclic control, it is likely that a solenoid valve will be best. Write us in detail and we'll be glad to make recommendations.

Bulletin 8302—Type EP-P39Z, 3-way pilot valve, explosion-proof; packless.



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use of rule-of-thumb calculations, and varied quality from batch to batch.

The process for manufacturing lubricating greases has proved highly successful. It has been in commercial operation for about four years, making lime grease at 60 lb. per min. or 86,000 lb. per stream day. It consists in first preparing a concentrated soap stock which is continuously blended with lube oil to produce a high yield grease, uniform in character and of superior quality. Material, labor and floor space savings over conventional batch methods are sufficient to amortize the plant in a relatively short time. Among the advantages of the continuous process, which uses a closed system, are the following: Problems of air entrainment and foaming are eliminated; since flashing is not resorted to, accurate moisture control is assured; incomplete saponification is eliminated by a recycle system; lumpiness, non-uniformity of product, and intermittent packing rates are eliminated by the constant grease rate, thorough blending, and the accurate control of temperature. These controls lead to a more stable grease.

H. G. Houlton, the Girdler Corp., before American Institute of Chemical Engineers, Louisville, Feb. 17, 1947.

Aluminum and Silicon Alloys From Clay

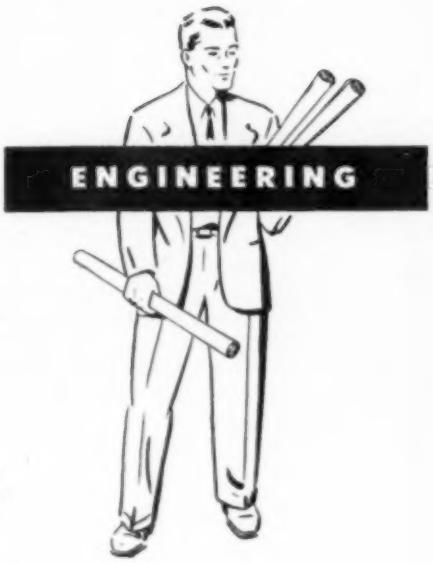
ENGINEERS of the TVA chemical engineering department at Wilson Dam, Ala., have developed a method of producing alloys of aluminum and silicon from ordinary white clay which is available in tremendous quantities in the Tennessee Valley region. In applying the method, clay is first heated in a kiln to drive off the water, and is then fed along with coke to an electric furnace which is operated at a high enough temperature to cause the coke and clay to react and form an aluminum-silicon alloy.

Aluminum-silicon alloys, which have reached pilot-plant scale production, were used successfully in large-scale tests for the deoxidation of steel and for the reduction of dolomite in the production of magnesium. There has also been considerable interest in the possibility of extracting pure aluminum and silicon metals from the alloys.

M. M. Striplin, Jr., TVA, before American Institute of Chemical Engineers, Louisville, Feb. 18, 1947.

Industrial Research and Its Importance to the South

NO NATION, no major section of a nation, no business, or industry can be economically secure without adequate, intelligently employed research



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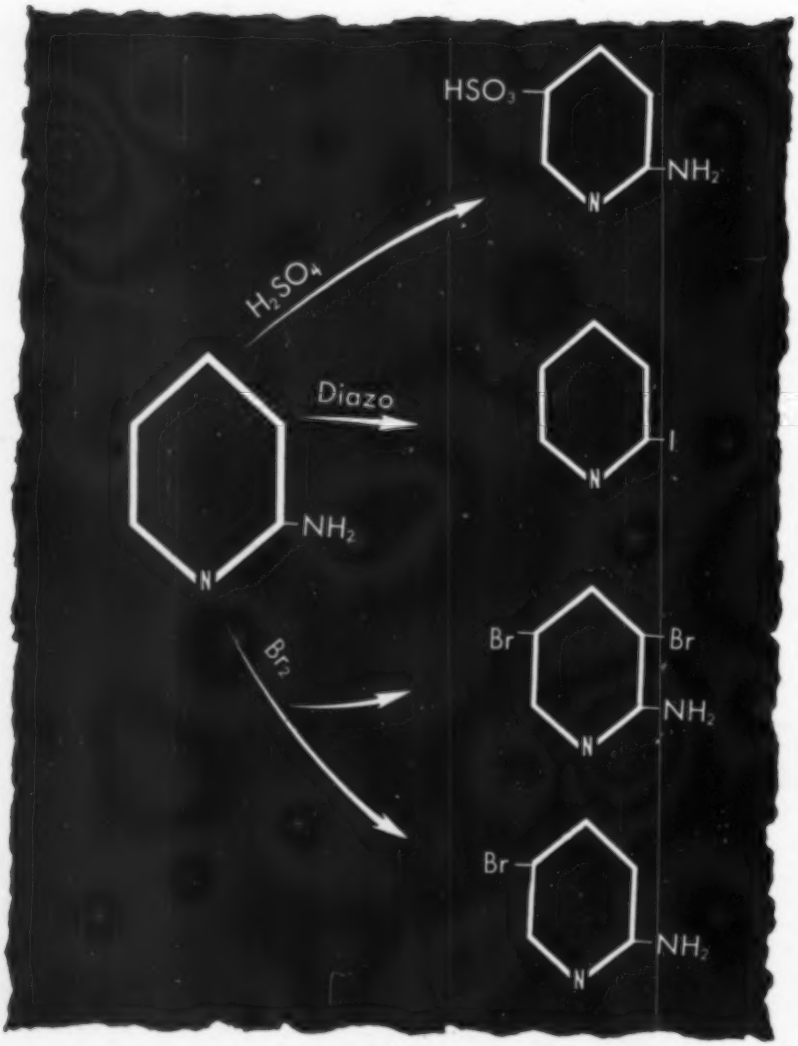
REILLY 2-Aminopyridine



This 56-page booklet will be sent on request.

● In an earlier printing was shown the chemistry of Reilly 2-Aminopyridine in the formation of sodium, chlorine and nitro compounds. Here are shown additional intermediates that can be readily formed from Reilly 2-Aminopyridine through bromination, sulfonation and the diazo reaction.

These compounds suggest the importance of Reilly 2-Aminopyridine as the basic material for the synthesis of pharmaceuticals, insecticides and fungicides.

In addition to 2-Aminopyridine, Reilly also furnishes four methyl aminopyridines, as follows: 2-Amino-3-Methylpyridine, 2-Amino-4-Methylpyridine, 2-Amino-5-Methylpyridine and 2-Amino-6-Methylpyridine.

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Reilly Coal Tar Chemicals For Industry

facilities, and without broad appreciation and prompt application of research results. Research and development are the keys which unlock the treasure chest of our natural wealth. Many nations throughout the world are rich in natural resources, but their people are miserably poor simply because they have not been able to use their wealth for their own advancement.

The results of research and development carried out in the South have substantially supported our peacetime advancement and our national strength in war. But abundant research possibilities still exist here to challenge the alert scientist and enterprising industrialist. One way of gaging the potential importance of research is to examine the fields which clearly are far from completely exploited. For example, there has been a very pronounced drift in population to the South from the Northeast and Central portions of the United States. In the period between 1936 and 1941, the population in the South increased well above the national average. It has, therefore, a much greater market to be served than existed before the war, and a greater reservoir of labor for further industrialization.

The need for expanding research endeavor parallels the industrialization of an area. It is, therefore, important to note how the industrialization of the South has progressed during recent years.

Every one of us interested in the welfare of the South naturally hopes that this upward trend will continue. The speed with which the South realizes its proper place in our national income scale is going to depend largely upon the type of research that is done to meet southern problems.

The resources of the South are many and important. It is heavily endowed with sources of energy. It has an ideal climate for agricultural development, and it has cheap transportation.

Regarding the markets served, there is the tremendous one which the South itself constitutes. It is difficult to say how the commercial demand created in this region by the sharp increase in per capita income can be met adequately without a still greater boom in local manufacturing enterprises. There is, in addition, the increasing national demand for those products exclusive to the South or which it can make better than other sections of the country. Southern industrial areas are also in an advantageous position to supply many of Latin America's growing needs for producer goods as its industrialization proceeds.

Adding up these numerous factors, it seems that the South offers opportunities for research and development

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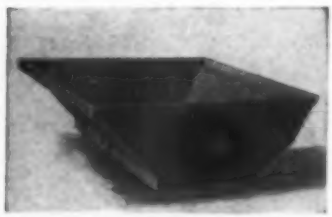

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which equal or perhaps even surpass those afforded anywhere else in the United States.

Research isn't a commodity that can be picked off a shelf—nor is successful research something that can be bought for mere dollars. It succeeds only through the technical sweat of well-trained, imaginative, competent, well-directed scientists who know the problems requiring the solution and who have the laboratories and other facilities needed to solve them.

Robert P. Russell, Standard Oil Development Co., before Southern Research Institute, Birmingham, Ala., Nov. 26, 1946.

Radioactive Poisoning By Plutonium

EFFECTIVE treatment of plutonium poisoning, daily peril to thousands of atomic energy workers, is promised by a new type of therapy now being tested at the Argonne National Laboratory, Chicago. Like radium, which disintergrates the bones, plutonium entering the body makes the skeleton the chief target of its deadly radiations, although an appreciable amount also is found in the liver and spleen. The new treatment employs zirconium, a relatively harmless metal, to drive the plutonium out of the body. Although still in the early experimental stage, the method has produced encouraging results.

Radioactive poisoning by radium has been a recognized danger for more than twenty years, but in that period no completely effective treatment for poisoning by radium or other long-lived radioactive substances has been developed. Now, it is said, the dangers of plutonium far exceed those of radium poisoning, because of the relatively large quantities of plutonium available and the number of individuals exposed.

Search for a treatment for plutonium poisoning was started early in 1945 under a Manhattan District contract and has been carried on at the Metallurgical Laboratory of the University of Chicago and at the Argonne National Laboratory.

Working on the theory that excretion of plutonium could be increased by treatment with certain metals, investigators sought metals with a metabolism similar to that of plutonium, so that they could be concentrated in the same parts of the body but in preponderant quantities. Preliminary tests indicated that zirconium was the most promising of the metals used, from the standpoint of safety as well as of effectiveness.

It appears that the zirconium first acts to displace plutonium from the liver and later migrates to the bone, where it slowly but continuously dis-

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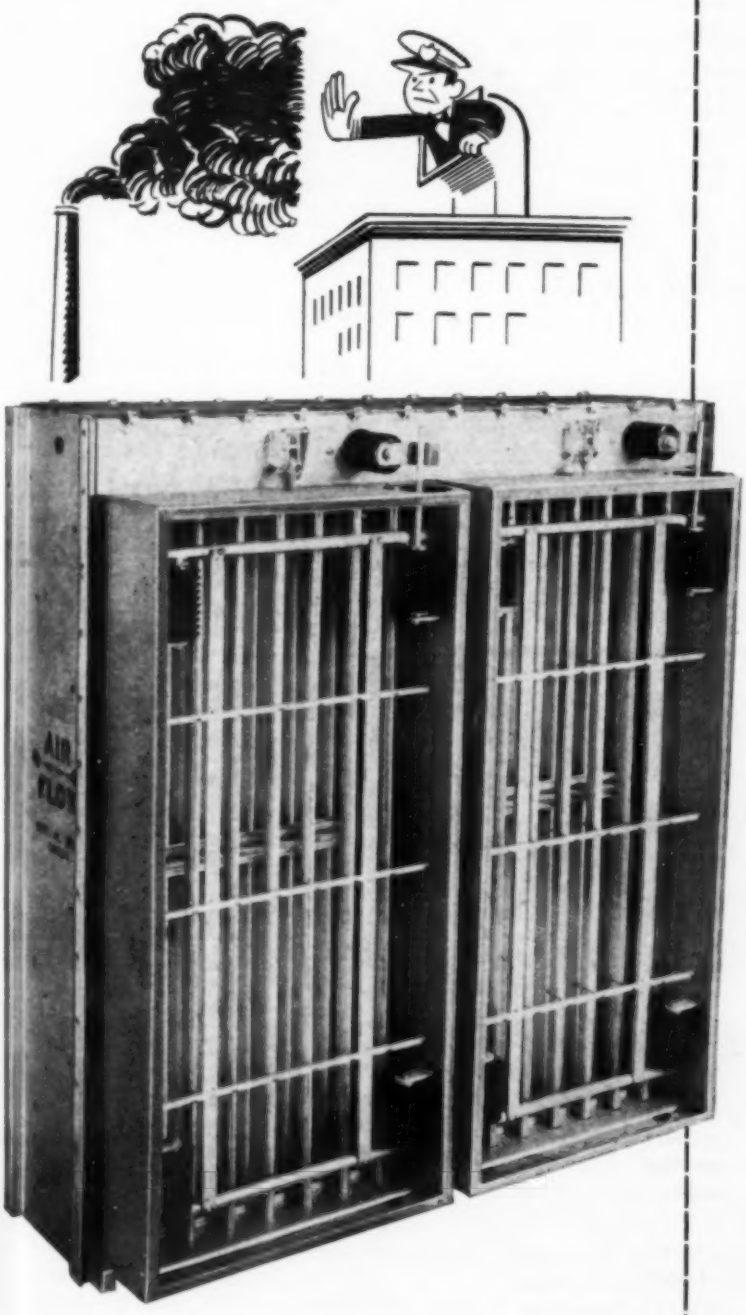
Smoke-free air?

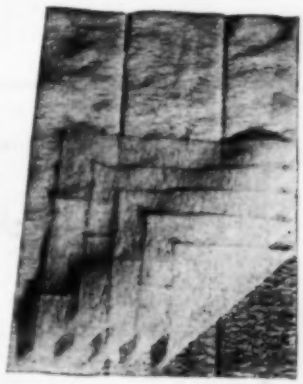


that's definitely an Electro-Airmat job!

SMOKE had air filters "buffaloed" for years. But no more—the Electro-Airmat averages 85% to 90% efficiency as compared to the 0% to 15% rating of ordinary mechanical filters for smoke removal.

That's a big difference and there's a reason. Electro-Airmat combines the best of both electronic and mechanical filtration. Airmat paper, a dry type filtering media used successfully for 20 years, serves as the collector element. Under electrostatic charge every fibre becomes a collecting electrode, attracting and holding minute smoke and dust particles which normally pass through mechanical filters.

Airmat paper simplifies maintenance, too. Its dust carrying capacity is increased 30% by electrostatic charge. When dust-loaded, you simply throw away and replace quickly with a clean sheet of Airmat. A reloaded filter is a new filter and all the fuss and muss of maintaining oil baths, removing sludge, washing and oiling collector plates is eliminated.



Airmat paper.

And you are never without protection. An Electro-Airmat can't quit on the job. If electronic action ceases due to power failure or in case of "stack effect" due to system design, Airmat paper continues to function as an efficient mechanical filter.

Smoke-free air? Sure you can have it plus these many other advantages with an AAF Electro-Airmat. Write for Catalog No. 253.

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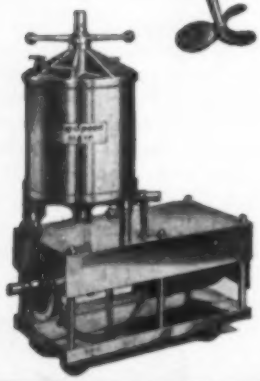

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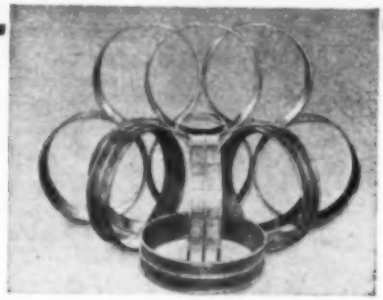
Centrifugal Dryer Screens



. . . a typical Hendrick product

These stainless steel screens for centrifugal drying of chemical materials are ⅛" thick with .015" milled and relieved slots on end-staggered centers. In fabricating these screens, tolerances as close as plus or minus .0001" were maintained; an example of Hendrick's expert workmanship.

Hendrick furnishes all types of perforated metal, wedge-slot and milled-slot screens, made exactly to specifications to meet the varied requirements of chemical industries. Write for complete information.

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places the deposited plutonium to an extent dependent on the concentration of zirconium relative to the plutonium. From a study of the toxicity of zirconium and other metals it was concluded that zirconium was by far the safest metal to be used therapeutically. No harmful chronic effects have as yet been found.

The action of sodium citrate in promoting the excretion of plutonium can be attributed to its ability to increase the diffusibility of plutonium and thus facilitate its clearance through the kidney.

Further investigations of metal displacement therapy in cases of chronic poisoning by plutonium and other long-lived radioelements are in progress.

Jack Schubert, before Chicago Section, American Chemical Society.

The Outlook for Synthetic Detergents

SOARING production of soap substitutes from petroleum and natural gas, which has reached almost half a billion pounds a year, is releasing an equal amount of fats to feed a starving world.

When synthetic detergents are made from petroleum or natural gas, every pound produced in place of soap saves about a pound of fats since almost all the fats used for soap can be refined to a grade suitable for food purposes.

First available on the American market in the decade preceding World War II, synthetic detergents came into their own during the war. They were especially important when, after V-J Day, the United States was attempting to meet its own soap requirements and at the same time relieve a fat shortage in the rest of the world. The synthetic detergents, as they took over part of these requirements, were the salvation of the American housewife and of industry. There was still a detergent shortage, but otherwise there would have been a worse one.

In round numbers, the United States consumes five billion pounds of detergents annually. Of this, the amount which is synthetic is already approaching the half-billion-pound mark and will pass it within a year or two.

The public can look forward to the increased use of these synthetic detergents in place of soap as a true economy. Manufactured on the same scale as soap, they can be made more cheaply than soap. The raw materials for various true synthetic types are kerosene, chlorine, natural gas, benzene, naphthalene, and caustic soda or soda ash. No one of these materials costs half as much per pound as fats and oils for soap.

Looking ahead, it appears that an

A TIRELESS "ARM" OF STEEL LETS HOT PIPE "ARCH ITS BACK"

● WHEN a big steam pipe system gets hot, it "grows" . . . often rising inches above its position when cold. This expansion would cause destructive strains, if crowded back into the system. The pipe must be allowed to rise.

The hangers supporting the pipe can't simply relax. As the pipe rises they must maintain the same lift, because the pipe weighs just as much hot as it does cold.

The Grinnell Constant-Support Hanger solves this tricky problem. It flexes as the pipe rises and settles, yet its lift never varies.

A Pipe Hanger that...

- ★ *Provides constant support to piping subject to vertical movement.*
- ★ *Maintains full safety factor in supporting high temperature, high pressure piping.*

GRINNELL CONSTANT-SUPPORT HANGER — the *only* constant-support pipe hanger.

● Spring forces are combined, with a lever arm, to compensate for the variations in supporting force inherent in helical coil springs, producing a supporting force that is always equal to the weight of the piping.

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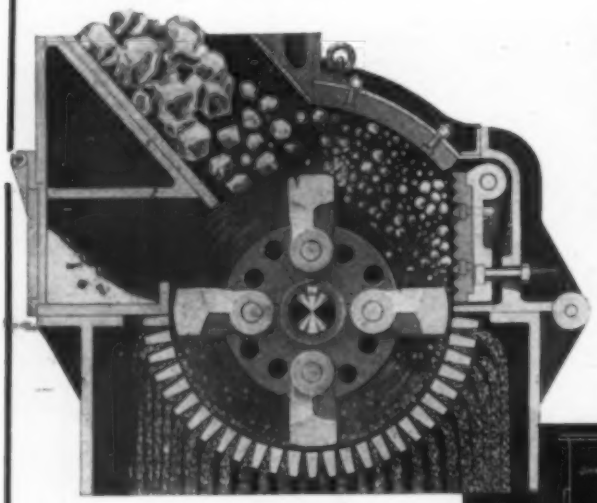
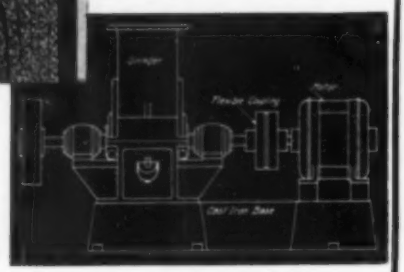


Sectional view of Williams over-running hammermill with heavy liners and grinding plate for limestone and other hard material. Particular attention is directed to the grinding plate adjustment which assures uniform close contact of hammers and grinding plate at all times. Also note the metal trap which provides an outlet for the escape of tramp iron.

Williams Hammer Grinder direct connected to motor, all mounted on heavy cast base. This type of drive is economical to operate and easy to install.



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increasing amount of the detergents will be entirely a factory product without drain on foods and the farm. In the near future with projected new production, they should exceed a billion pounds a year.

Foster Dee Snell, Foster D. Snell, Inc., before Carolina-Piedmont Section, American Chemical Society, Charlotte, N. C., Feb. 21, 1946.

Formation and Application Of Phosphate Coatings

First commercial use of phosphate coatings was for the protection of iron and steel from corrosion and followed the proposal of Coslett of England in 1908 to treat iron and steel articles in a hot dilute phosphoric acid solution with a control agent such as iron filings. This process, later modified and considerably improved, contains the fundamental principle on which the more recent methods of phosphating are based. It required from 2 to 2½ hr. for production of phosphate coatings by the Coslett process, which seriously restricted its use. The use of metal accelerators and suitable oxidizing agents in the phosphating solution expedited the coating formation and made possible the production of paint base coatings on metals within 2 to 5 min. Combining spray application with such accelerated phosphate solutions containing an oxidizing agent, further reduced the coating time to as low as 2 to 10 sec. Heavy corrosion-preventive type coatings are usually produced by immersion application and require from 30 min. to 1 hr. to produce. The phosphate coating on non-ferrous metals such as zinc, aluminum and their alloys is increasing in commercial use to prevent corrosion and increase the adhesion of applied paint coatings over such surfaces. In recent years phosphate coating of bearing surfaces has been used extensively to retard wear. A most recent industrial application of phosphate coating steel is to facilitate drawing. This application has been in industrial use in Europe for several years; it has gained industrial application in America since 1941.

Van M. Darsey and W. R. Cavanagh, Parker Rust Proof Co., before The Electrochemical Society, Toronto, October 1946.

Radioactive Isotopes In Medicine

Isotopic methods of determining the total amount of body constituents consist of injecting a "tracer" for the body constituent to be measured, allowing the radioactive material to equilibrate, and then withdrawing a fair sample to determine the dilution of

Photo: Courtesy of Henry Vogt Machine Co., Louisville, Ky.

ONE OF BRIDGEPORT'S CONDENSER TUBE ALLOYS MAY SOLVE YOUR CORROSION PROBLEMS

No one metal or alloy can be expected to withstand the many different corrosive elements encountered in chemical plants, petroleum refineries and food processing industries. Bridgeport has developed a number of condenser tube alloys designed to meet a wide range of operating conditions. Selection of the tubing best suited for a particular application requires considerable experience and knowledge. Bridgeport maintains a consistent program of corrosion research involving laboratory work as well as field and service tests. Contact the nearest Bridgeport office for technical service to help reduce premature tube failures, and write for 112-page Condenser Tube Manual.

ARSENICAL ADMIRALTY—for handling sea water or polluted fresh circulating water, hydrocarbon gases containing sulfur compounds, lubricating oils, gasoline, naphtha, etc.

ARSENICAL MUNTZ*—excellent for resisting high sulfur compounds as well as dezincification from corrosive water. More effective than ordinary Muntz.

CUZINAL—superior to Admiralty for resisting air impingement corrosion or erosion-corrosion produced by high water velocities. Resists dezincification and sulphide corrosion encountered in condensers and coolers handling various types of petroleum products.

CUPRO NICKEL—resists stress corrosion cracking caused by moist ammonia, oxygen and stress. Shows good resistance to caustic and other alkaline liquids and salt solution. Fine resistance to air impingement corrosion produced by high sea water velocities.

RED BRASS—resists corrosive waters and hydrocarbon vapors. Better for resisting stress corrosion than Admiralty or Cuzinal, but not recommended for severe sulfur corrosion.

DURONZE IV**—excellent for circulating sea water and brackish waters polluted with wastes. Gives fine service conducting hot brine in salt refineries and corrosive liquids in many processing plants.

DUPLEX TUBING—for double corrosive conditions too severe for single metal or alloy—extensively used in ammonia refrigeration systems and heat exchangers and condensers handling a wide variety of organic and inorganic chemicals. Available in Red Brass, Copper, Cuzinal, Cupro Nickel, Muntz, and Duronze IV . . . with steel, aluminum, stainless or monel. Inner and outer tubes are selected to combat a specific corrosive element and mechanically combined to give good heat transfer. Our Technical Bulletin No. 746 covers applications and methods of installing Duplex Tubing.

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...two catalysts designed, as the name implies, for the hardening of fish oils and tallow or when conditions of hydrogenation are difficult.

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• The Selectols, companion products of the Resistols—a group of catalysts designed for the hydrogenation of all edible fats and oils.

the isotope. Then, by a simple calculation, it is possible to determine the total amount of material in which the isotope has equilibrated and become diluted.

One might liken this method to taking a barrel full of an unknown number of green apples and mixing in a known number of red apples. When the red and green apples were thoroughly mixed, it would be possible, determining how many green apples there were for one red apple, to calculate how many green apples were in the barrel, without counting them.

By this method, using radioactive sodium, chloride, bromide, potassium, iron, and "heavy water," we have been able to measure and calculate the total body water, the extracellular water, intracellular water, plasma volume, red cell volume, total body potassium, total body sodium and concentration of potassium in the cells. By extension of these measurements in the future, we can hope to arrive at methods by which a patient sick in bed can be "dissected" by using tiny doses of radioactive isotopes in as accurate a fashion as any chemist could ever analyze the animal body.

By such measurements, our concepts of fluid balance and therapy and our methods in the administration of sodium, chloride, potassium, glucose, protein, blood, and plasma may be put on the firm foundation of quantitative measurement.

Francis D. Moore, Massachusetts General Hospital and Harvard Medical School, before the American Pharmaceutical Manufacturers' Association, New York, Dec. 9, 1946.

Fluidized Powder Techniques

VAST improvement of a wide variety of important industrial processes, including the manufacture of gasoline, lime, and powdered coke, is promised by a new technique for controlling chemical reactions of powdered materials. Ready control of temperature, rapid mixing of the reacting substances, and intimate contact of the mixed particles are chief advantages of the technique which consists of suspending a powder in a stream of gas or liquid flowing upward.

The fluidized powder technique is finding its main use in the fluid catalytic cracking process, but it is also being developed for a number of other purposes, such as the burning of limestone to make lime, oxidation of hydrocarbon compounds typical of petroleum, manufacture of fuel gas from coal, processing of powdered coal into coke, and similar operations.

In the case of the fluid catalytic cracking process, the advantages are

ENGINEERING PROGRESS REPORT # 12

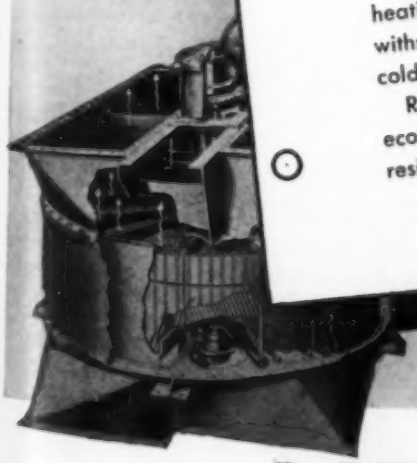
LJUNGSTROM AIR PREHEATER

CORROSION-RESISTANT ALLOY FOR HEATING ELEMENTS

The removable cold end of the Ljungstrom heating element (upper left) and sections from which the cold end has been removed for purposes of illustration.

In the Ljungstrom, the replaceable cold end is made from a special corrosion-resistant alloy that reduces maintenance and replacement. In addition, the heating elements at the cold end are made from heavier gage metal to withstand the impact of the mass soot blower and lengthen the life of the cold end.

Replacement of the cold end of the heating surface is rapid, easy and economical. Standard equipment on all new installations, corrosion-resistant cold ends can be applied to older Ljungstrom air preheaters.



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The collaboration of our Research Department is freely available in developing the application of "Virginia" SO_2 to your processes. Let's talk it over . . . at your plant or ours. VIRGINIA SMELTING COMPANY, West Norfolk, Virginia.

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the excellent temperature control and the ease with which the powdered catalyst can be revived or replaced when it becomes "tired." Temperature control and intimate contact between air and the powdered materials are the chief virtues in the burning of limestone and the oxidation of hydrocarbons. In the coking of coal, advantage is taken of the fact that the rapid transfer of heat through the coal makes it possible to use low temperatures effectively.

Since the fluidized powder method has a number of characteristics not common to other solid-fluid contacting devices, it is certain to find a broad application in the chemical industry.

The mixing of the solid and the transfer of heat from the solid to the stream of gas are so rapid and thorough that constant temperature can be maintained even when heat is being produced unevenly. This characteristic is of utmost importance in a number of processes.

Carbon, for example, can be removed from the surfaces of fine powder particles by burning without danger of a runaway increase in temperature, and in cases where the temperature rises above a desirable level, the powder can easily be removed, cooled, and put back into the system.

A large number of installations employing fluidized solids are in use and although a great many studies have been made, no general correlations have so far been developed.

The data indicate that the shape, size, density, and concentration of the particles and the velocity of the fluid are important. It is also fairly well established that a variation of particle size must be present.

Edwin R. Gilliland, Massachusetts Institute of Technology, before Rochester Section, American Chemical Society, March 17, 1947.

Physicists in Training

THE WELL-KNOWN shortage of physicists has led to much speculation concerning the numbers of student trainees in this science to be graduated at various levels in the next few years. The American Institute of Physics had prepared a list of the names of 532 institutions which were supposed to graduate students with an undergraduate physics major. A survey indicates that this number is too high by more than 100, i.e. there are probably less than 400 colleges which this academic year will graduate students with a bachelor's degree in physics. The number of institutions offering graduate work in physics at the doctorate level is surprisingly small, about 60.

The data obtained for the number of Ph.D. candidates expected to be

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DIAGRAM OF BELT IN PULLEY GROOVE

Look at a V-Belt in its sheave and you see at once that the *sides* of the belt do all the gripping on the pulley and get all the wear against the sheave-groove wall.

Notice, too—it's the *sides* that pick up all the power delivered by the driver pulley. The sides *transmit* that power to the *belt as a whole*. And then, once more, it's the sides—and the sides *alone*—that grip the driven pulley and *deliver* the power to it.

That is why you have always noticed that the sidewall of the ordinary V-Belt is the part that wears out first.

—and Here Is How the CONCAVE SIDE *REDUCES Sidewall WEAR and Lengthens Belt Life!

Clearly, since the sidewall is the part that wears out first, anything that prolongs the life of the sidewall will lengthen the life of the belt.

The simple diagrams on the right show exactly why the ordinary, straight-sided V-Belt gets excessive wear along the *middle* of the sides. They show also why the Patented Concave Side greatly reduces sidewall wear in Gates Vulco Ropes. That is the simple reason why your Gates Vulco Ropes are giving you so much longer service than any straight-sided V-Belts can possibly give.

Straight Sided V-Belt

How Straight Sided V-Belt Bulges When Bending Around Its Pulley

You can actually feel the bulging of a straight-sided V-Belt by holding the sides between your finger and thumb and then bending the belt. Naturally, this bulging produces excessive wear along the middle of the sidewall as indicated by arrows.

Gates V-Belt with Patented Concave Sidewall

Showing How Concave Side of Gates V-Belt Straightens to Make Perfect Fit in Sheave Groove When Belt Is Bending Over Pulley

No Bulging against the sides of the sheave groove means that sidewall wear is evenly distributed over the full width of the sidewall—and that means much longer life for the belt!

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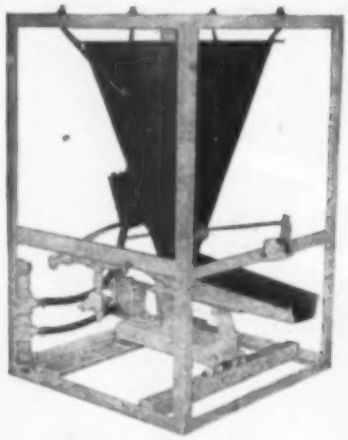

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graduated during the year 1946-47 indicates a total of 180 to 200. This value is very close to the figure for 1940-41, the last normal prewar year. About 900 other doctoral candidates are currently enrolled who may be expected to try for their degrees in later years.

The survey shows that about 700 students expect to receive their M.S. degree this year and about 1,000 are enrolled for this degree in later years. The number of physics majors who expect to receive a bachelor's degree in 1946-47 amounts to about 1,500, while those for 1947-48 are 2,300, and for 1948-49 the numbers are about 2,400. These numbers are considerably higher than for prewar years, the estimated increases averaging about 73 percent.

These data indicate that the shortage of physicists is likely to be filled much earlier than was previously estimated.

Marsh W. White, The Pennsylvania State College, before American Association of Physics Teachers and American Physical Society, New York, Jan. 30, 1947

Silicones—New Engineering Materials

ALTHOUGH carbon and silicon are both tetravalent, the chemistry of the silicones is markedly different from that of purely organic compounds. For example, in all of the silicone compounds studied to date the silicon atoms are linked through oxygen atoms instead of to each other. $SiCl_4$, unlike CCl_4, is unstable in the presence of moisture and reacts with alcohol to form $(C_2H_5O)_4Si$.

Silicones may be classified as fluids, compounds or resins. Dimethyl fluid was the first to be studied extensively. Its hydraulic applications are somewhat limited by a high volume coefficient of expansion, but a low dielectric constant and power factor makes it useful as a liquid dielectric in relays, condensers, etc., and for ceramic treating to render high surface resistivity. In common with many of the silicones, dimethyl fluid is an excellent foam inhibitor, concentrations as low as 1 ppm. preventing foaming in diesel and aircraft engines.

For lubricating oils and heat transfer mediums, other organic radicals are substituted for the methyl group. Outstanding use has been on high temperature conveyors, both chain and bearing types, as well as on instruments, clocks, etc., at both high and low temperatures. General characteristics of this type silicone are a temperature range of −40 to 500 F., less than 10 percent loss after exposure to 482 deg. F. for 48 hr., no gum formation after 1,000 hr. at 482 deg. F., minimum

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Tee flanged fitting

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Esco flanged fittings are available in 45- and 90-degree elbows, tee, long radius ell, cross, 45-degree lateral, and reducer. Sizes range from ½" to 10".

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Other products of Esco "know-how" which result from years of experience in the pulp industry, are stainless steel valves, screwed and socket-weld pipe fittings, Spuncast and fabricated stainless steel pipe. These are described in the new stainless steel Catalog number 157. We have a copy for you. Ask your nearest Esco representative for it, or write us direct.

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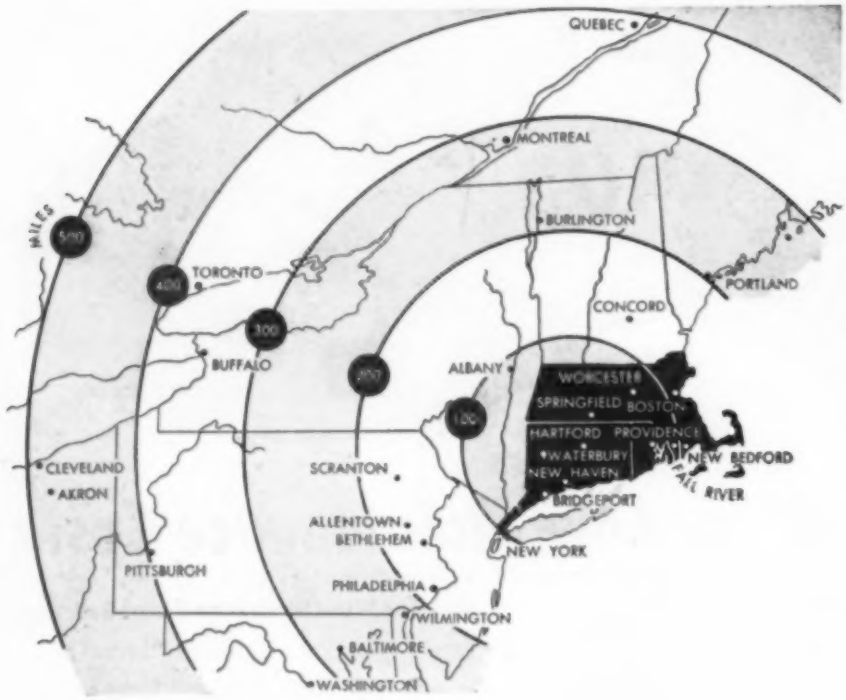

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Other silicones with boiling points of 750-810 deg. F. have proved to be excellent oils for high vacuum diffusion pumps.

Compounds, prepared with silicones, have properties closely related to the dimethyl type fluids and are used as a sealing medium in aircraft ignition harnesses, as a filling medium to exclude moisture from switches, relays, etc., and as an effective foam killer in latex emulsions, adhesives, etc. Silicones have also been used in grease compounds to produce neutral and inert greases having excellent water resistance and low volatility. Capable of being used in bearings up to 10,000 rpm., satisfactory greases have been developed with temperature ranges of −95 to 200 and −40 to 482 deg. F.

Silicone resins, bonded with asbestos or other high-temperature material, are put through a molding schedule somewhat longer than phenolics and also through a baking schedule. Silicone-Fiberglas laminates have excellent dielectric and power factor constants, high arc resistance, are non-tracking and may be operated at temperatures up to 482 deg. F.

Surface coatings prepared from silicone resins are heat stable to 482 deg. F. and have good weathering and chemical resistance. They are suitable for furnace breechings; but they must be thermo-set. Silicone electrical insulating varnishes are useful up to 450 deg. F., have good dielectric strength and water resistance and low volatility.

The same fillers and vulcanizers are used in silicone rubbers as in natural rubbers. More fireproof than conventional rubbers, silicone rubbers have a temperature range of −70 to 500 deg. F. Electrical properties are similar to other silicones. Resistance to heavier oils is poor, but in a test only 2.5 percent by weight was lost after exposure to an SAE 30 oil for 22 days at 350 deg. F.

Present day prices for silicone paints are about $30 per gal. Hydraulic oils run about $47 per gal. with the probability that they will ultimately be around 75c. per lb.

H. L. Boulton, Dow-Corning Corp., before the Northern California Chapter, AIChE, San Francisco, Feb. 3, 1947.

Magnetochemical Study Of Catalysts

CHEMICAL industries spend fantastic sums in making, replacing and improving catalysts which make possible

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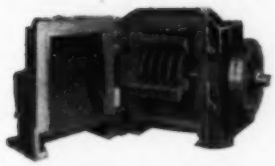
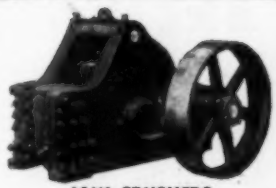


SWING-SLEDGE MILLS

for coarse and medium reduction (1" to 20 mesh). Open door accessibility. Soft, moderately hard, tough or fibrous substances. Built in several types and many sizes.



JAW CRUSHERS

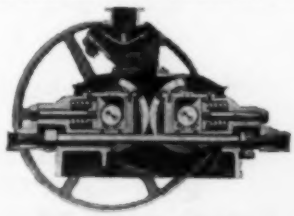
for coarse, intermediate and fine reduction of hard or soft substances. Heavy or light duty. Cam and Roller action. Special crushers for Ferro-alloys. Several types, many sizes.

RING-ROLL MILLS

for medium and fine reduction (10 to 200 mesh), hard or soft materials. Very durable, small power. Operate in closed circuit with Screen or Air Separator. Open door accessibility. Many sizes. No scrapers, plows, pushers, or shields.

MOTO-VIBRO SCREENS

screen anything screenable. Classified vibrations. Unit construction — any capacity. Open door accessibility. Open and closed models with or without feeders. Many types and sizes — range of work ½ inch to 60 mesh.



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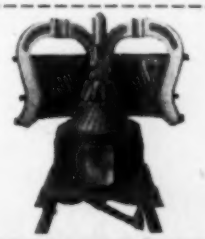
for granulation, coarse or fine, hard or soft materials. Automatic adjustments. Crushing shocks balanced. For dry or wet reduction. Sizes 8x5 to 38x20. The standard for abrasives.



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for intermediate and fine reduction (1" to ¼"). Open door accessibility. Soft or moderately hard materials. Efficient granulators. Excellent preliminary Crushers preceding Pulverizers.

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Of all the precious assets your plant possesses, none is more important than the hands of your workers!

And dangerous undesirables in any worker's washroom are "fiery" hand cleaners whose strong alkaline or harshly abrasive action tends to irritate or injure the skin's surface, making it more susceptible to infection.

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Neither dangerously high nor ineffectually low, Sulpho's pH is ideally neutral; its emulsive action gentle, not grinding.

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the economical manufacture of gasoline, fertilizers, plastics, drugs, and many other products. In most cases, however, no one knows just how the catalyst does its work.

A new magnetic technique has furnished a flood of information as to the actual architectural structure of the atoms within catalysts, leading to a better understanding of how they affect chemical reactions. As a result of these studies, better catalysts have already been designed for some processes, and it is possible that there will be at least a partial answer to the old problem of "how does a catalyst work." A sample of the catalyst to be tested is chilled in liquid nitrogen and then suspended by a thin quartz fiber between the poles of a powerful electromaget. Under the influence of the magnet the catalyst turns slightly. Changing the angle at which the catalyst is suspended, the operator performs the experiment several times, each time observing the amount of twist due to magnetic attraction. Correctly interpreted by a method devised at Northwestern University, the results reveal many of the secrets of the catalyst.

The new technique is also proving useful in the study of high polymers, such as plastics and rubber. It enables chemists to tell to what extent certain groups of molecules are arranged in an orderly fashion.

Strength and lasting qualities of plastics often depend on how the molecules are arranged. Any tool or measurement which shows how the molecules are arranged means a possibility of better, longer lasting plastics. The method has been applied to such diverse substances as plexiglass, natural and synthetic rubber, cellulose, and many others, and has proved to be most useful as applied to polymers containing benzene derivatives.

P. W. Selwood, Northwestern University, before St. Joseph Valley Section, American Chemical Society, South Bend, Ind., March 15, 1947.

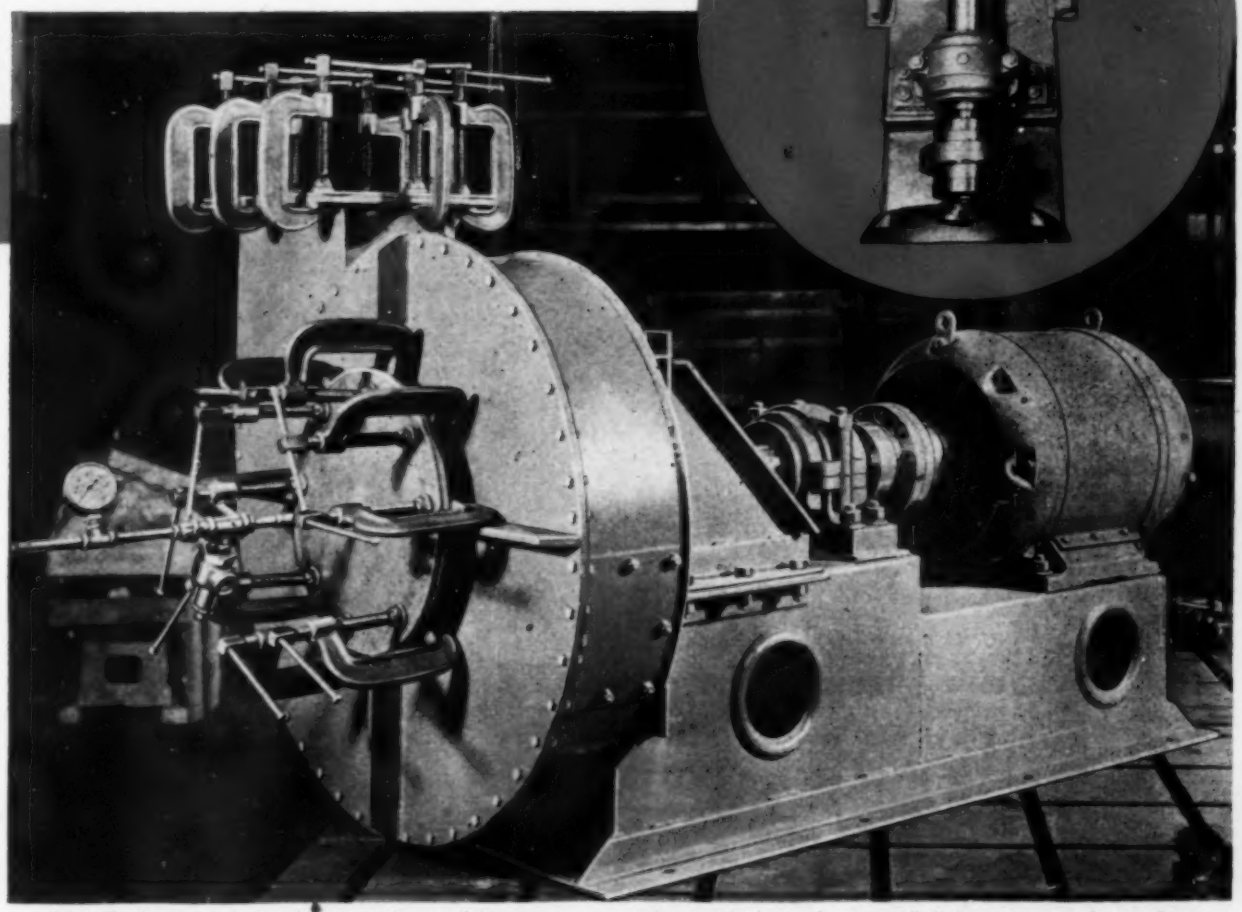
Non-Atomic Benefits From Atomic Engineering

DEVELOPMENT of atomic energy has created a new and vast field of organic chemistry with immediate and far-reaching applications to the nation's chemical industry. A whole new class of plastics, lubricants and solvents already has been made available as a result of research on the preparation of uranium for the atomic bomb project. The new peacetime materials, made chiefly of fluorine and carbon, were developed to provide special protection for the equipment and substances employed in the gaseous diffusion process.

The tremendous effort and expense

GAS-TIGHT...

RIGHT FOR THE JOB



Shut-off plates are fastened with C-clamps while air pressure in housing is boosted to specified line pressure. Insert shows husky, precision construction of shaft and bearings . . . also gas-tight stuffing box.

Where you have fumes to handle and want to keep them where they belong—a Buffalo Gas Exhauster is the answer to your problem.

Heavy steel plate construction with flanged inlet and outlet connections, stuffing box suitable for the service, and high efficiency Buffalo Rotor—such a fan is pressure-tested (as shown above) and leaks, if any, detected by soap bubble test. When you secure one of these gas-tight exhausters, it's ready to go to work.

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Big—these hooks weigh 700 lbs. apiece. Tough — they practically live in a 140° F. bath of 6% sulphuric acid without any ill effects.

You see, these hooks are made out of corrosion- and acid-resistant Grade 18 Ampco Metal. That is why they carry out their rigorous job day after day — why their trouble-free performance reduces down-time and increases pickling-tank production.

Although you may not have need for pickling hooks such as these, remember: If you are faced with corrosion, erosion, abrasion, or cavitation problems — if you have to handle such liquids as acids, petroleum sludge, alkaline solutions, sea water, mine waters, hot brine, or food-product liquors, Ampco Metal is the answer.

Available in seven grades, this engineered aluminum bronze alloy can be obtained in the form of castings, forgings, sheets, and rods. It is without equal for low-cost corrosion- and acid-resistant fabricating.

Ask our engineers to help you adapt assemblies fabricated out of Ampco Metal to your requirements. Send us your prints for suggestions. Write for bulletins.

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P-17

which went into building the Oak Ridge plant have yielded great dividends to the engineering profession, because so much of the work was entirely new.

Among the notable developments have been the advances in vacuum engineering. A continuous mass spectrometer for process analysis was developed for recording the concentration of contaminants with substantially no time lag. Development of vacuum-tight globe valves which can be opened and closed hundreds of times before seat leakage sets in will be of great importance to the low-pressure process industries. Knowledge gained by pump manufacturers in designing high-ratio centrifugal compressors has notably advanced the art of designing similar machines for air, refrigerants and other gases. Development of methods for applying an adherent internal nickel plate to steel pipe should be of great value in many other processes treating corrosive chemicals.

Perhaps the most important outgrowth of the whole development is the improved understanding of other separation processes obtained by comparing them with gas diffusion. Through study of the principles of the gas diffusion process, chemical engineers will learn new ways of thinking about and improving distillation and other familiar separation processes.

Manson Benedict, Hydrocarbon Research, Inc., before the Division of Industrial and Engineering Chemistry, American Chemical Society, Pittsburgh, Dec. 30, 1946.

Chemical Engineering Aspects Of Reaction Kinetics

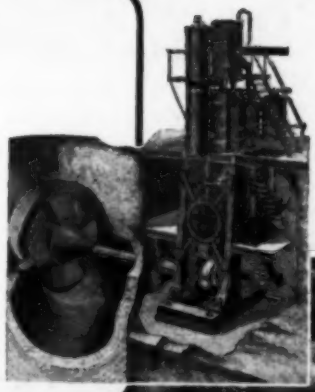
CHEMICAL engineers are responsible for the design and operation of reactors for optimum over-all process economy. Generally the reactor is of the flow type with attendant pressure and temperature gradients. The problem is further complicated in most cases by the occurrence of numerous simultaneous and successive reactions which influence both the conversion and selectivity.

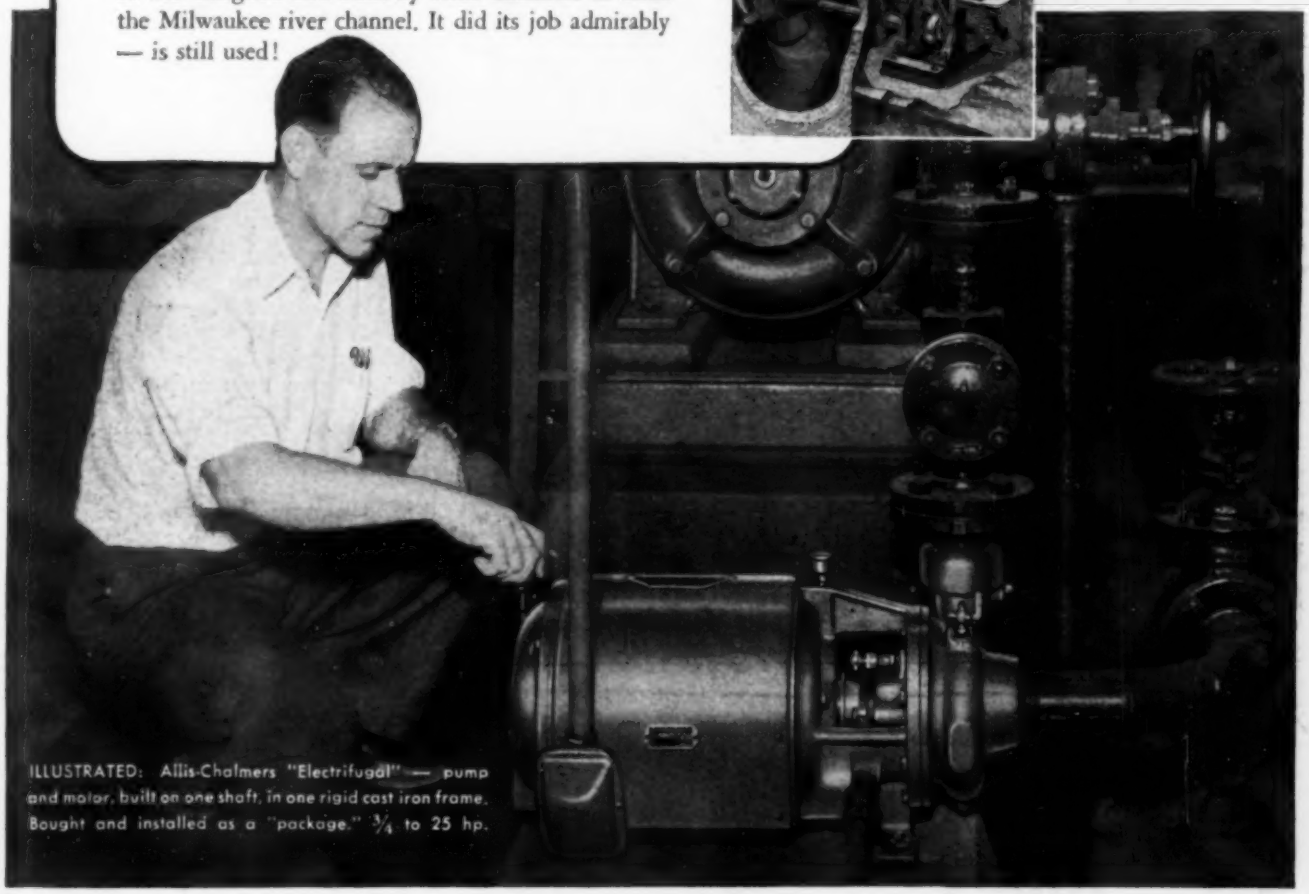
Much of the difficulty in handling the kinetics of flow systems has resulted from the illogical use of "residence time" as a correlating variable. If this variable is abandoned in favor of the space velocity concept logical equations may be developed in terms of absolute reaction rates which are applicable to any system. Such relationships are applied to complex reactions by integrations which include separate consideration of the significant diffusional, adsorptive, and chemical phonomena. By this method the kinetic behavior of systems involving as many as ten individual reactions has

IN 1888:

This pump made a river run faster . . .

It was designed and built by Allis-Chalmers to flush the Milwaukee river channel. It did its job admirably — is still used!





ILLUSTRATED: Allis-Chalmers "Electrifugal"— pump and motor, built on one shaft, in one rigid cast iron frame. Bought and installed as a "package." ¾ to 25 hp.

TODAY: Allis-Chalmers pumps move nearly all liquids with unusual economy!

WHETHER YOU need a pump to move a river of water — or liquids high in solid content — or to develop tremendous pressures — or need just a small, compact and highly economical pump like the "Electrifugal" unit illustrated above . . . Allis-Chalmers probably makes what you want.

To fit your needs, trained A-C representatives select exactly the *right* pump and motor combination from a truly *complete* range of equipment. No need to recommend an approximation—undivided responsibility for the efficient performance of both pump and motor.

For more detailed information call your nearest A-C office or dealer, or write for Bulletin 6059-C. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN. A 2211

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Oversize ball bearings, extra shaft diameter, deeper stuffing box, conservative rating...and final testing to meet your operating conditions...will keep you sold on this Taber "general-use" Pump.

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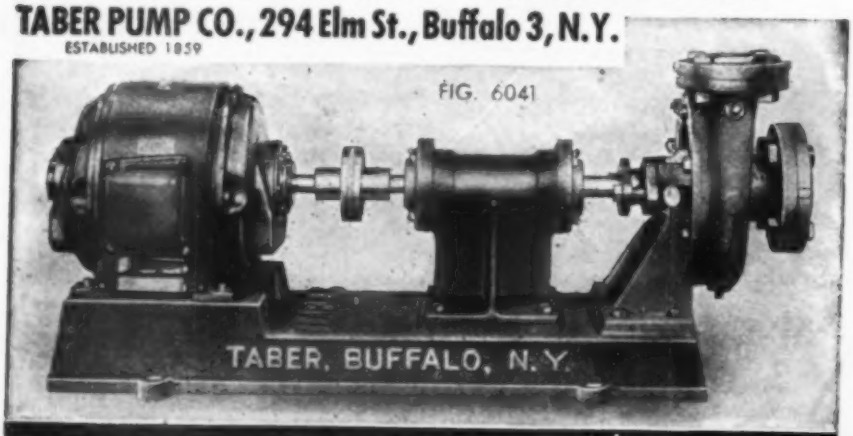

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been correlated with accuracy sufficient to permit prediction of the operating results of commercial reactors.

K. M. Watson, University of Wisconsin, before Division of Chemical Education, American Chemical Society, Atlantic City, April 15, 1947.

War Department Research Practices

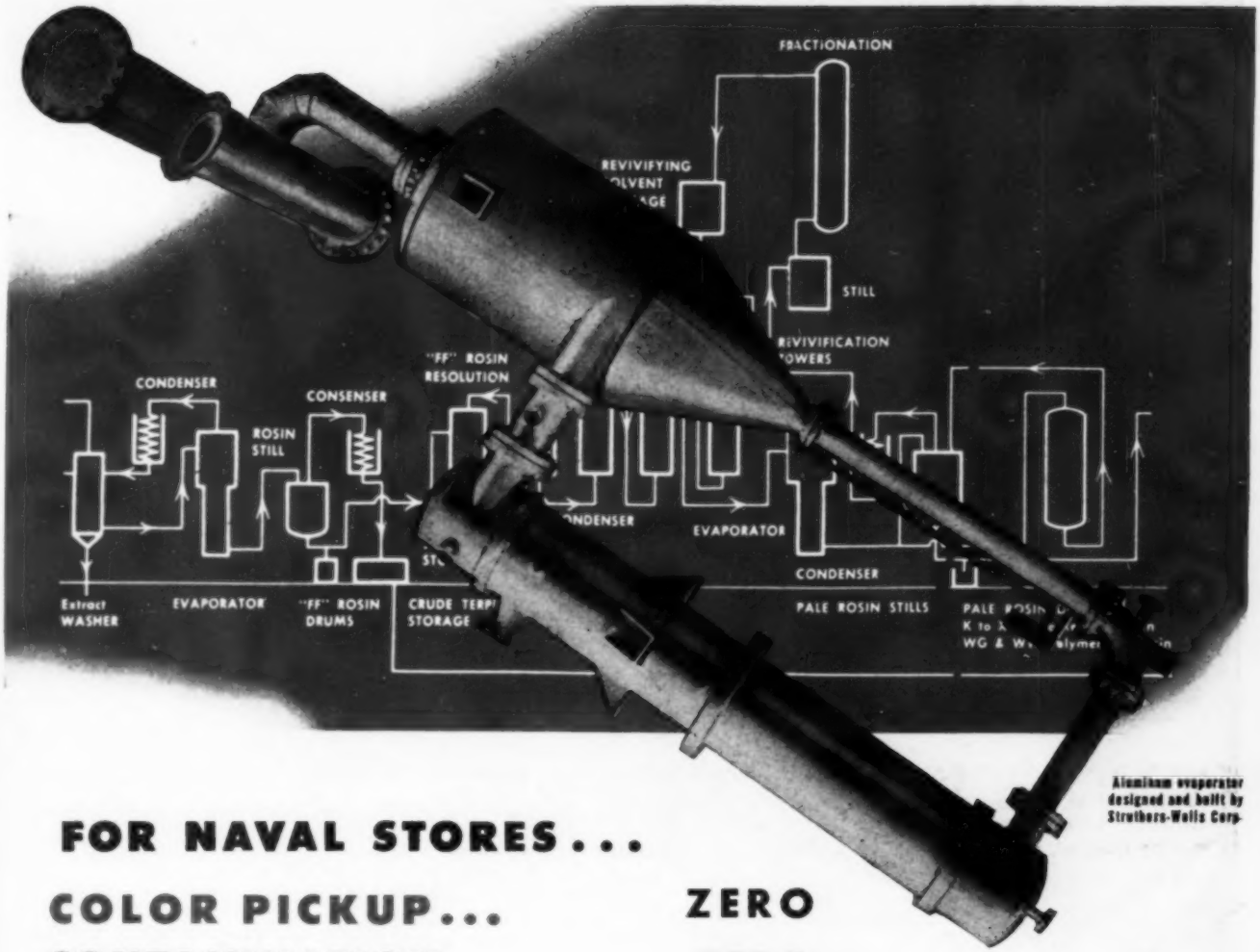
THE War Department makes no pure research contracts for the purpose of subsidization of anything. It does not in any way attempt to imprison the scientist, nor are we trying to militarize science. We realize that subsidization, imprisonment of science, or militarization will keep us from getting the basic information which we need. It would be folly for us to so defeat our own ends.

Appropriations are made annually. All of the money so appropriated must be obligated in the fiscal year for which the money is appropriated. That is to say, we must either make expenditures or contracts during the fiscal year for which the money is appropriated. However, on the contracts we are allowed to make payment for two years thereafter, or for a total period of time of three fiscal years. This means that at the end of each fiscal year, there is a carry-over of obligated but unexpended money. To assist the War Department in effecting this continuity, we are asking Congress to make money available for expenditure for four years after the year in which it is appropriated, rather than for two, as provided in present law.

The Army alone expects to expend in fiscal year 1947 an estimated $270 million from its research and development funds. In fiscal year 1948 the estimate is that $250 million will be expended. This is based on the President's budget estimate to the Congress for the fiscal year 1948, wherein he asked for the appropriation of $222 million.

Of this $220 million, about $20 million will be put out in pure research contracts. The remainder will be spent for the end items resulting from applied research and development and, within the War Department for scientific and engineering payroll and the necessary supplies to maintain the laboratories in which these scientists and engineers are to work.

For the $20 million for pure research, the same ratio holds between funds applied to development and those applied to research. Educational institutions have a very small percentage of the development contracts (about 3 percent), whereas they have about 20 percent of the pure research contracts. The great majority of the funds with which these contracts are



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This Struthers-Wells vertical high-velocity evaporator is used in a naval stores plant to handle rosin-naphtha solutions. The evaporator, surface condenser, and feed preheater are all built of Alcoa Aluminum.

Service life has been better than originally expected, production efficiency of the unit is high. And the rosin-naphtha solutions are not contaminated nor discolored by contact with the aluminum.

Whatever you process in your chemical plant, whatever you plan to buy or build as equipment, give a thought to Alcoa Aluminum. Aluminum can offer you lower maintenance cost, better heat transfer, and freedom from contamination for many chemical operations. Let our experts on the design and building of process equipment of Alcoa Aluminum help you. ALUMINUM COMPANY OF AMERICA, 2151 Gulf Bldg., Pittsburgh 19, Pa.

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Testing . . . *Research and laboratory testing units also provide instrument controlled heat, vacuum and humidity factors as desired.*

Unit pictured is standard 5 cu. ft. Bowser Chilling Unit for dry or wet processing at sub-zero temperatures.

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financed are from fiscal years prior to 1947, about 44 percent being from fiscal years prior to 1946, about 49 percent from 1946 funds, and about 7 percent from 1947. Of course, as the fiscal year 1947 will not terminate until June 30, this proportion will increase.

If we continue our present placement ratio, about 20 percent of the $20 million which will be placed in fiscal year 1948, or $4 million, will go to pure research contracts with educational institutions. This figure should convince all that the War Department is not going to buy up all the scientists or the scientific laboratories in the country; or place such an undue burden on the laboratories of educational institutions that no other work can be undertaken.

Practically all research work is done on contract rather than in War Department establishments, except where certain special equipment or facilities must be made available. The best illustration of pure research work done within the War Department is that done by the ballistic research laboratory at Aberdeen, which requires ballistic ranges for its operation. These do not normally exist in industrial laboratories or educational institutions.

Major General H. S. Aurand, director of research and development, War Department, before American Physical Society and American Association of Physics teachers, New York, Jan. 30, 1947.

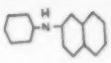
New Developments in Chemical Engineering Curricula

As in other fields of education, the methods and purposes of engineering curricula are being re-examined and evaluated. There has been a call for increased emphasis on the basic sciences, more objective inclusion of the humanistic-social subjects, and transfer of the more specialized subjects of the undergraduate curriculum to the postgraduate period. The new curricula in chemical engineering now often comprise three parallel sequences, in the sciences, engineering, and humanities, which extend throughout the undergraduate program. In order to accommodate the broader programs, an early concentration of the basic sciences and mathematics in the curriculum emphasizes dependence on sound secondary school training. This has often proved inadequate. Several schools have adopted five-year curricula leading to professional degrees. There has been a considerable increase in graduate work in chemical engineering, often with greater emphasis on the master's degree than on the doctor's degree.

Chemistry courses occupy an important place in the curriculum for chemical engineering and good teaching in these is essential. Much can be

B. F. Goodrich Chemical Company

has available for sale these organic chemicals



Phenyl B Naphthyl Amine

Distilled—Available in commercial quantities
M. P. 107°
Purity 99.5%
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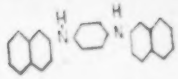

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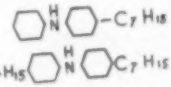
Available in commercial quantities
M. P. 230° C
Purity 98%



Mixed Mono-and Diheptyl Diphenyl Amines

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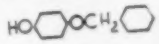
Distillation range—145-245 (3.0 mm)
Purity 98%

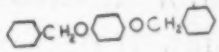


Monobenzyl Ether of Hydroquinone

Available in commercial quantities
M. P. 113°
Purity 90%

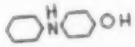
Isopropoxy Diphenyl Amine

Available in commercial quantities
M. P. 78°
Purity 92% min.



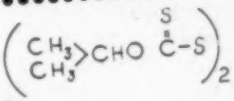
Dibenzyl Ether of Hydroquinone

Available in Pilot Plant quantities
M. P. 119°
Purity 85%



p Hydroxy Diphenyl Amine

Available in commercial quantities
M. P. 150°
Purity 92%

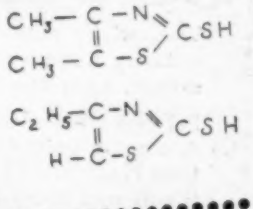


Di Isopropyl Dixanthogen

Available in commercial quantities
M. P. 52°
Purity 98%

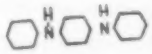
N-Nitroso Diphenyl Amine

Available in commercial quantities
M. P. 62°
Purity 97%



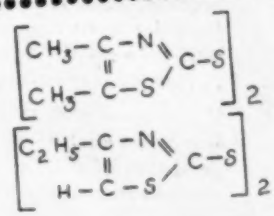
Mixed Ethyl and Dimethyl Mercaptothiazoles

Available in commercial quantities
M. P. 136-153°
Purity Approximately 85% dimethyl and 15% ethyl mercaptothiazoles



Diphenyl p Phenylene Diamine

Available in commercial quantities
M. P. 144°
Purity 92%



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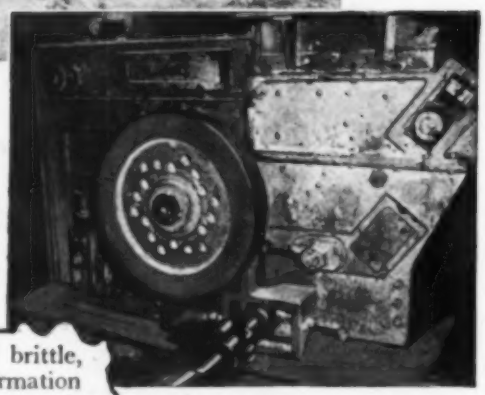

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done toward coordinating the subjects. For example, the early use of pound molar quantities and English units will prepare the student for the stoichiometric computations which are essential to his training. New techniques of measurements and analysis are important in the applications of instrumental control. A knowledge of organic chemistry is useful to the chemical engineer in the petroleum field and is essential in many of the process industries. Chemical technology can best be studied as an application of the principles of physical chemistry, especially of colloidal and amorphous substances, to engineering practices. Thermodynamics in chemical engineering must include the energy transformations in flowing fluids, heat transfer, refrigeration, and high pressure effects, as well as reaction equilibria. Much interest is being taken now in reaction kinetics, especially in continuous heterogenous catalytic processes. While these subjects are found only in the advanced undergraduate and graduate courses, preparation for them must be carried on through the science and engineering sequences.

H. F. Johnstone, University of Illinois, before Division of Chemical Education, American Chemical Society, Atlantic City, April 16, 1947.

Fiberglas Packing in Gas Absorbing Systems

Basic principles are dependent upon physical phenomena which cross unit operation boundaries and tie them together in the theoretical approach. One such tie is the diffusional principle, which is common in all operations involving material transfer between any two phases. Since transfer must be through a surface, a logical procedure for the increasing of the transfer rate would involve a increase of the surface contact.

Early investigations were made in the attempt to increase the transfer rate between gases and liquids which were of extreme importance in distillation, gas absorption, gas stripping, humidification, and similar operations. The search led to towers for the transfer, with packing materials inside the towers to disperse the liquid in large area, and present at the same time a tortuous path for the gaseous phase. The literature shows that although many materials were tried, few were chosen, and the favored few are compromise acceptances. The search continues.

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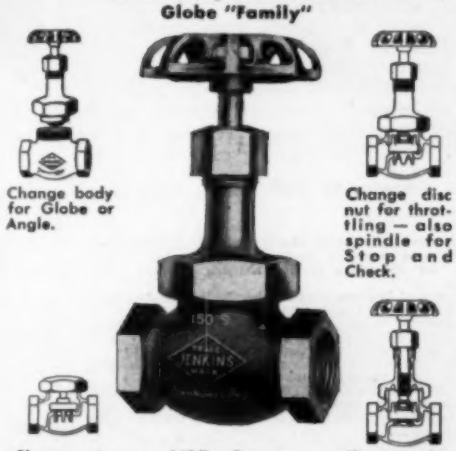
Change body for Globe or Angle.
Change disc nut for throttling — also spindle for Stop and Check.
Change trim, add spring as desired, for Lift Check.
150 lbs. Steam 300 lbs. O.W.G
Change spindle for Quick Opening.

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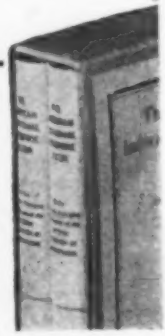

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What are the roles of prices and profit in our enterprise system? (See chapters 9–10)
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At the beginning of the World War II, the government strongly requested that the distilling industry convert their facilities from the making of a 105 proof to the production of 95 percent industrial alcohol. It likewise was extremely hesitant in making the necessary materials available for the expansion, and the money available for the necessary expenditure. The industry was faced with seemingly insurmountable barriers and gratefully grasped at the glass fiber straw which was new and untried, but which was available and which looked good. The results were not 100 percent satisfactory, but they indicated that the Fiberglas had a place in the field of tower packings.

G. C. Williams, R. B. Akell, and C. P. Talbott, University of Louisville, before regional meeting of the American Institute of Chemical Engineers, Louisville, Feb. 17, 1947.

FOREIGN LITERATURE ABSTRACTS

Organomercury Complexes for Prevention of Wheat Decay

EXPERIMENTS on the prevention of wheat decay with some furan and mercury-furan derivatives showed that the most active complex is furfurol-mercuric chloride, which is formed by the combination of one molecule of $HgCl_2$ with a molecule a furfurol. Since this compound is more efficient in preventing decay in grain than mercuric chloride at the same concentrations, and since its toxicity in the earth is less, which affects the germinating capacity of the wheat, it was considered desirable to determine what other compounds of this type have similar properties. For this purpose, several complexes were chosen which were formed by combination of mercuric chloride with various aldehydes, such as anisaldehyde-mercuric chloride, salicylaldehyde-mercuric chloride, cinnamaldehyde-mercuric chloride, metanitrobenzaldehyde-mercuric chloride and piperonal-mercuric chloride, which were prepared for the first time by one of the authors. The complex phenanthrenequinone-mercuric chloride, prepared for the first time by Japp and Turner, was also tested. The products for seed treatment were prepared by dispersing 8 parts of the complex, dis-

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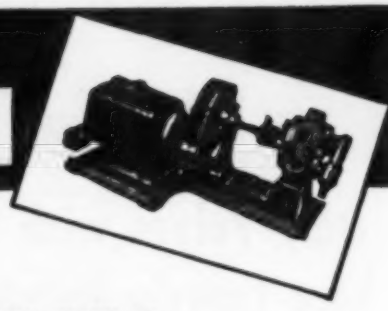

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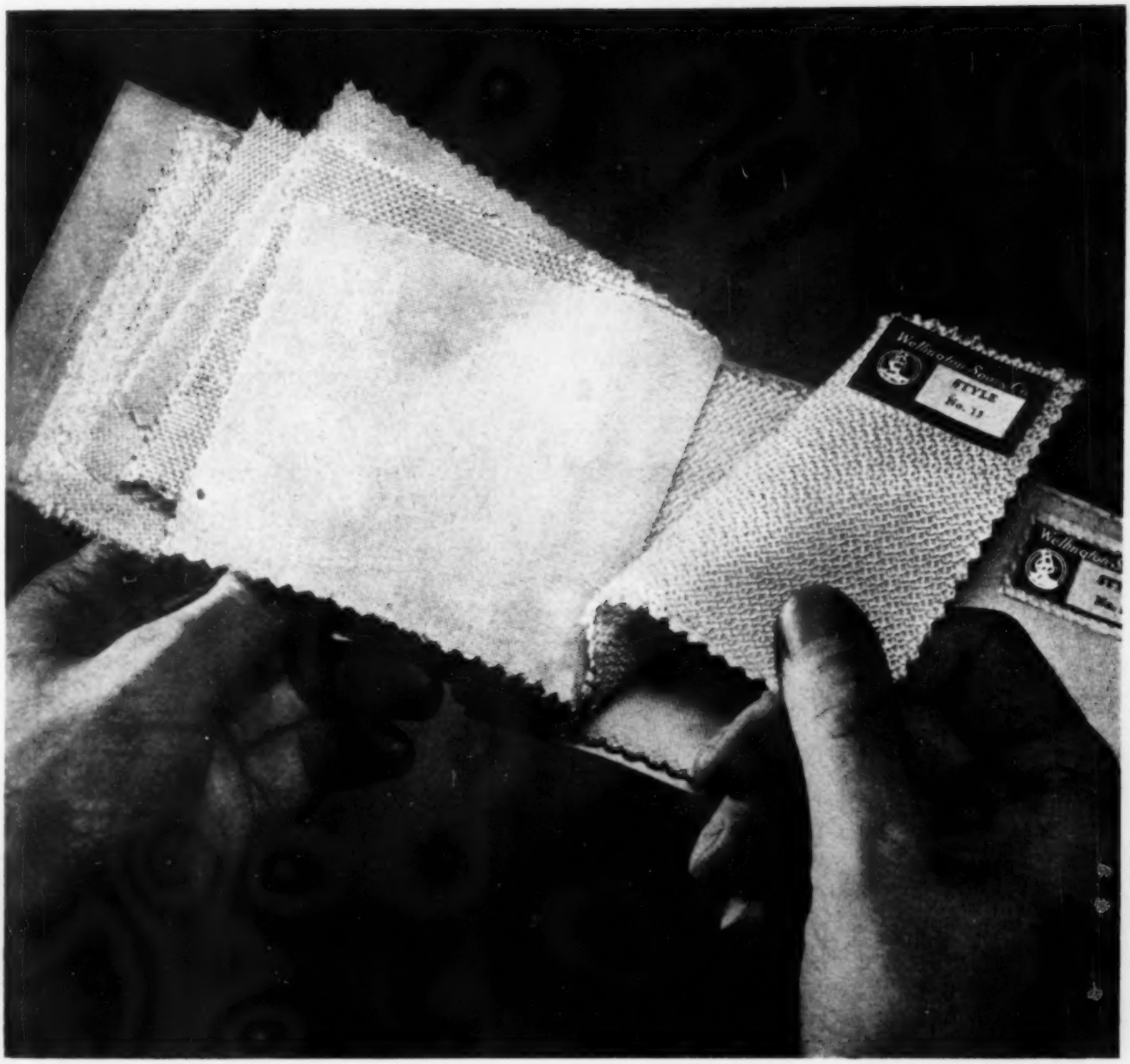

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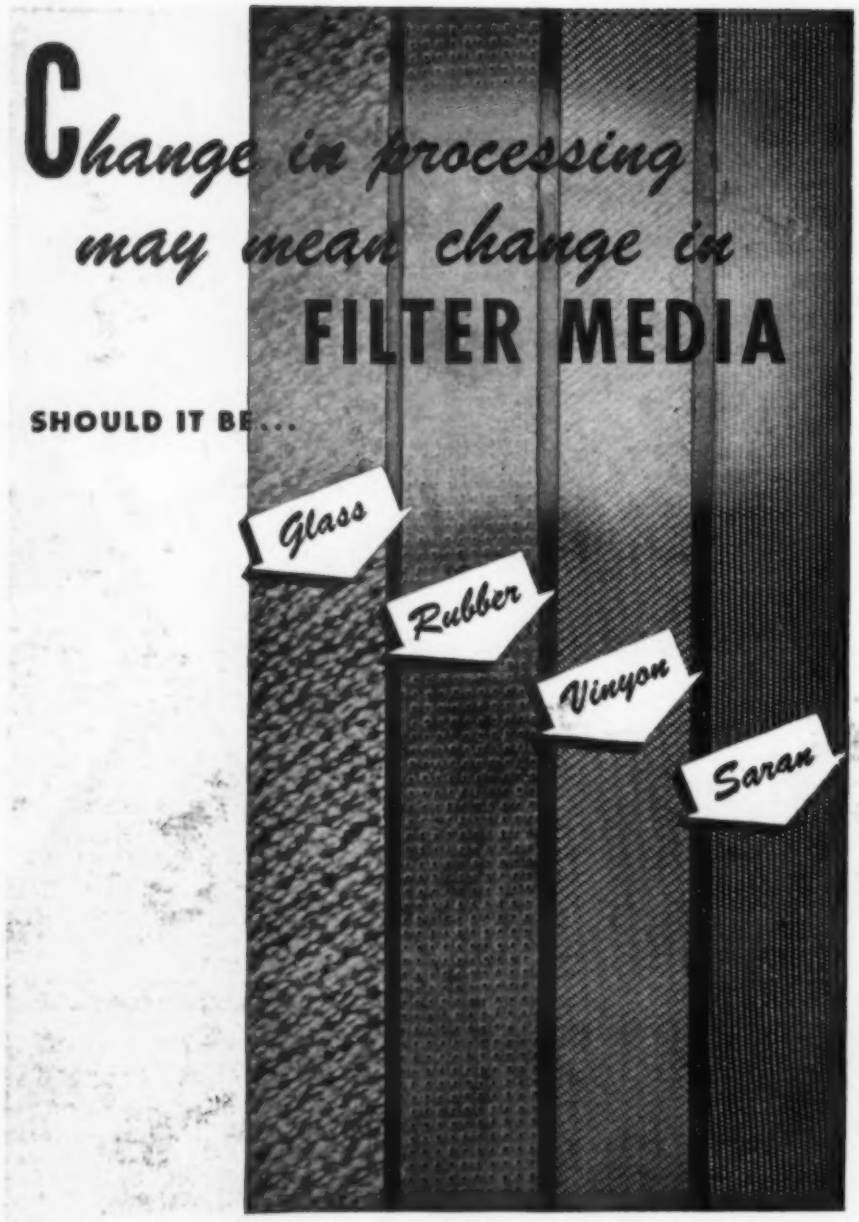

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solved in a suitable solvent, in 92 parts of talcum, except for phenanthrenequinone-$HgCl_2$, which was used in a proportion of 4 to 96. The mercuric chloride complexes with anisaldehyde, salicylaldehyde and metanitrobenzaldehyde showed outstanding disinfectant properties in relation to spores of *Tilletia tritica*. Cinnamaldehyde-$HgCl_2$ and piperonal-$HgCl_2$ were also found to be very active, whereas phenanthrenequinone-$HgCl_2$ showed a perceptible activity.

Digest from "The Action of Some Organomercury Complexes in the Prevention of Wheat Decay" by G. B. Marini-Bettolo and Giovanni Borzini, *Ricerca Scientifica e Ricostruzione* 16, No. 8, 1145-1147, 1946. (Published in Italy.)

Calcium Carbide Reducer

CALCIUM carbide is a strong reducer which acts on halides through the calcium, the carbon being set free simultaneously with the metal. With alkali-earth chlorides, the reactions are limited by the volatility of these chlorides at the required temperatures. The yield is increased by the use of less volatile fluorides. The reactions are as follows:

$$BaF_2 + CaC_2 \rightarrow CaF_2 + 2C + Ba$$
$$SrF_2 + CaC_2 \rightarrow CaF_2 + 2C + Sr$$

The arrangement used is similar to that of A. Guntz. His principle was to condense the metal which distills in the vacuum on a steel tube traversed by a current of cold water. Heat is produced by a high-frequency current generator which induces Foucault's currents in the graphite crucible where the reaction takes place. 14 g. of $BaCl_2$ mixed with 10 g. of CaC_2 heated 2 hr. at 1,300 deg. C. gives approximately 4 g. of metal per 4 percent Ca (30 percent yield). 20 g. of BaF_2 and 10 g. of CaC_2 heated 2 hr. at 1,400 deg. C. gives 7 g. of metal per 6-7 percent Ca (50 percent yield). Similar results are obtained with strontium.

Digest from "Action of Calcium Carbide on the Alkali-Earth Chlorides and Fluorides" by M. Bernard, *C. R. Acad. Sci.* 221, Nos. 10, 11, 12, 13, 296-298, 1945; *Chimie et Industrie* 56, No. 3, 222, 1946. (Published in France.)

Thermic Treatment for Glass

HEAT for fusion of glass can be supplied by high-frequency currents, an electric arc passing above the mass to be fused, or some outside resistances radiating over the surface of the bath. This procedure would have some advantages if it were suitable for industrial application. Thought has also been given to immersing the arc or resistances in the fused mass. Heat can be supplied by the Joule effect, the electrodes being inserted into the fusion mass and the glass serving as a

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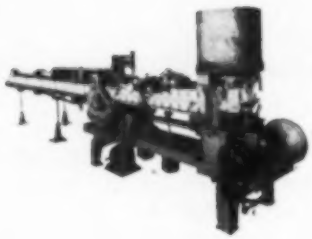

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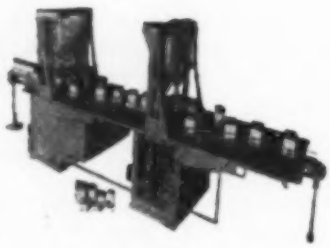

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resistance placed between the electrodes. There are furnaces which utilize this procedure and capable of a daily production of 12 tons, but the glass is always contaminated by the products of the reaction of the bath on the electrodes. Research was conducted to find a way to avoid the contact of the bath with the electrodes. In the case of glass, heating by induction in a high-frequency furnace would require a wave length on the order of a meter and is not really practical. Utilization of heat by dielectric losses has been considered and the principle is as follows: in a perfect dielectric condenser the tension and the current are in quadrature and the dielectric does not undergo any heating, but for real dielectrics, the dephasing decreases and the dielectric becomes heated. A formula shows how the dissipated power varies with the potential, pulsation, etc. A crucible containing the vitrifiable material is constructed and submitted to the electric field of a condenser to the terminals of which a high-frequency tension is applied. Waves of 15-60 m. are used and a power of 60 kw. This method of heating has a number of advantages, but a material must be found for the crucible which undergoes less dielectric losses than the glass. This procedure should find application in the treatment of special glasses produced in fairly small quantities and the cost of which is not of primary importance.

Digest from "Application of Heat by High-Frequency Currents for Fusion and Thermic Treatment of Glass" by M. Descarsin, *Bull. Soc. Franc. Electr.* 5, No. 45, 70-86, 1945; *Chimie et Industrie* 56, No. 2, 123-124, 1946. (Published in France.)

Mexican Strontium

STRONTIUM was of no particular importance in Mexico before World War II, but the use of this metal in pyrotechnical preparations during the war stimulated its production. In 1935-39 most of the United States strontium imports, which reached an average of 3,700,000 lb., came from Germany. By 1943, however, Mexican production had reached 6,100,000 lb., coming chiefly from one of the central states, San Luis Potosi. The Mexican mineral kept a good price due to its high content (96 percent) of strontium sulphate. The deposits of San Luis Potosi are considered to be particularly important as a source of supply of strontium in the western hemisphere during the postwar period. One of their advantages is their ready accessibility by highway or railroad. In addition, San Luis Potosi is only a short distance from the United States border.

Digest from "Mexican Victory Minerals" by Eugenia Ysita, *Industria Minera* 62, 85-92, 1946. (Published in Argentina.)

CHEMICAL ENGINEER'S BOOKSHELF

Lester B. Pope, ASSISTANT EDITOR

Completely Rewritten

INDUSTRIAL CARBON. *Second edition. By C. L. Mantell. D. Van Nostrand Co., New York. 472 pages. $7.50.*

Reviewed by James A. Lee

MUCH has happened since the first edition of this book was prepared and published 18 years ago to make it necessary to rewrite the material completely. This new volume is a splendid collection of all of the information available on the various forms of carbon. Dr. Mantell has not only drawn on his own vast knowledge of the subject but has had the cooperation of other recognized authorities.

Elemental forms of carbon: the diamond, natural graphite, carbon black, acetylene black, lamp black and pigments, with their uses constitute the first section of the volume. Wood carbonization and charcoal, the subject of a chapter in the first edition, has been omitted. The adsorptive forms make up the second section. Manufactured forms: artificial graphite, electrodes, brushes, arc light carbons, specialties and resistors, materials of construction, porous forms, electronic tube anodes, and refractories, represent additions, new products, industrial satisfaction of needs, and developments brought about in the train of our chemical, physical, electronic and radio progress—these constitute the third section. In the final part are collected together analytical and testing methods applied to all forms of carbon; and properties which vary so widely as a function of shape, particle size, previous history, and manufacturing technique, are tabulated and coordinated.

Most chemical engineers will find something of interest in this volume. The chapter on carbon as a material of construction will be invaluable to the engineer looking for data on the mechanical characteristics and the corrosion resistance of carbon and graphite. Electrodes are treated at considerable length. The chapters on gas adsorbents, vegetable decolorizing, carbon and acetylene black should be of interest to many, to mention only a few of the topics.

Facts and Pictures

OIL FOR VICTORY. *By the editors of "Look." McGraw-Hill Book Co., New York. 287 pages. $3.50.*

Reviewed by James F. Cosgrave

REGARDLESS of the ultimate aim, oil stores were the immediate targets of our enemies in World War II. Japan quickly captured the oil fields of the Far East, and Germany succeeded in isolating most of the Red Army's oil supply. Thus America was left with the gigantic task of producing and delivering enough oil to meet all needs of the Allied cause.

Largely pictorial—but with a surprising number of facts and figures—the book presents an accurate and moving account of the story behind the problems of oil transportation, research and development of new products, and industrial expansion. Written for the layman in a dramatic manner, it is well worth the while of anyone interested in learning how the petroleum industry met the challenge and supplied our overseas operations with twice as many tons of oil and oil products as the combined total of all other types of cargo, including men, food, munitions and equipment.

Tough Going

MESON THEORY OF NUCLEAR FORCES. *By Wolfgang Pauli. Interscience Publishers, New York. 69 pages. $2.*

Reviewed by G. F. Kinney

THIS represents notes on lectures given in 1944 at M.I.T. to research workers in nuclear science. It is a survey of the recent literature, some forty references being given, nearly all of them within the past decade. The presentation is mathematical and the accompanying descriptive material is on a comparable plane, thus terms such as ansatz, eigenfield, and Euler angles are utilized without attempts at explanatory detail. Proper emphasis is given to the provisional state of the problems in question and to the experimental data of most immediate need.

RECENT BOOKS RECEIVED

The Chemistry of Commercial Plastics. By R. L. Wakeman. Reinhold. $10.

Organic Analytical Reagents. Vol. I. By F. J. Welcher. D. Van Nostrand. $8.

Physical Constants of Hydrocarbons. Vol. IV. By G. Egloff. Reinhold. $17.50.

Revised Edition

GERMAN-ENGLISH SCIENCE DICTIONARY. *By Louis de Vries. McGraw-Hill Book Co., New York. 558 pages. $4.50.*

THIS second edition of Mr. de Vries' dictionary has been revised so as to make it more useful to chemists. There are also many additional terms in the fields of biology, physics, mathematics, geology, agriculture and forestry, so that this edition contains 85 more pages of material than the earlier one. To help the translator, the appendix contains a conversion table, atomic table, thermodynamic symbols, electric units of measure, and other data.

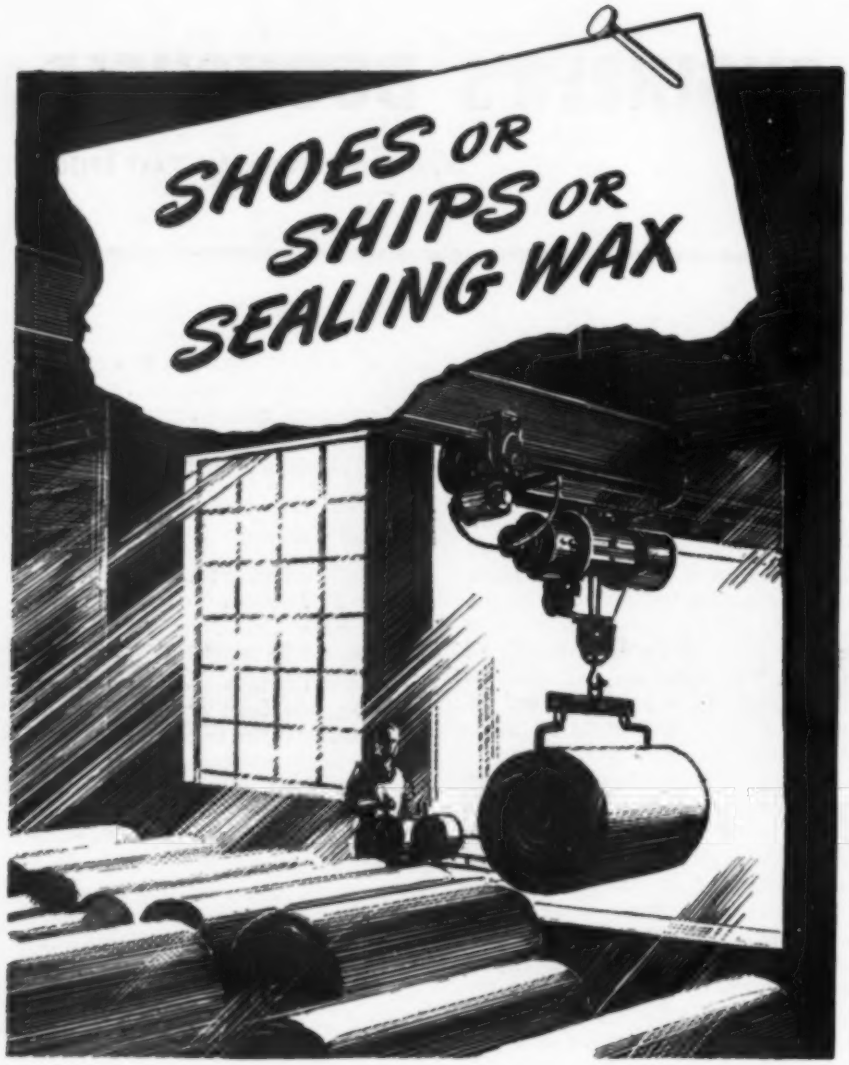
Constructive Sincerity

PLASTICS BUSINESS. *By Herbert R. Simonds and Joseph V. Sherman. D. Van Nostrand Co., New York. 439 pages. $5.*

Reviewed by Myron A. Coler

THE differences between technological possibilities and commercial probabilities and actualities in the plastics industry are real and the disparity is often great. Opinions vary from those of pessimists who consider plastics to be an overrated fad to those of equally uninformed optimists who expect plastic houses and automobiles by next season. The present volume is concerned primarily with the business aspects of the plastics industry. The book provides in a readable and not-too-technical form the type of information which a potential investor should have as a minimum basis for rational analysis. Because of its commendable breadth, the book will also prove of interest to plastic formulators, molders and others who are not concerned principally or solely with the business phases.

The detailed content of the book is well indicated by the chapter headings: Description of the Industry,



Regardless of what you make, it's safe to assume you have the problem of lifting, moving and depositing raw materials, semi-finished or finished products. Where such loads involve weights from ⅛ to 20 tons and where they must be handled smoothly, easily, economically and efficiently, consider the advantages of Shepard Niles hoists.

America's oldest builder of electric hoists and cranes offers you more than 5,000 styles and sizes from which to make your selection. Without obligation on your part, trained, experienced Shepard Niles engineers will study your requirements and recommend the hoist most suitable for the job.

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Characteristics of Materials, Organization of the Industry, Companies' Statistics, Growth of the Plastics Industry, Sales and Profits in Plastics, Prices of Plastics, Consuming Statistics, The Future of Plastics, The Investor and the Technician, Foreign Markets for Plastics, Effects on Other Industries, Plywood, Synthetic Rubber, and Trade Names. There is some duplication of material which, however, is helpful in rendering the individual chapters substantially independent.

An important feature of the book is the inclusion of some 160 reference tables in addition to charts and photographs which serve to document many of the statements of the text and to convey a significant amount of supplementary information in a minimum of additional space. There are a few elisions and unhappy phrases, e.g., p.51—" . . . the use of such products as wood flour, lignin, lignin-enriched fiber and powdered walnut shell as "extenders" or plasticizers is increasing", p.139—"Santocel, a silicone material . . ." The over-all sense of balance is good; although the book confidently predicts a several-fold growth of the industry and paints a generally encouraging picture, pitfalls and moot points are discussed with constructive sincerity.

Industrial Relations

THE INDUSTRIAL REPUBLIC. *By P. W. Litchfield. The Corday & Gross Co., Cleveland.* 201 *pages.* $4.

Reviewed by Chaplin Tyler

EQUALITY of responsibility among the three components of the Nation's industrial economy—labor, capital, and the consumer—are necessary in order to achieve a satisfactory solution of the "labor" problem.

This in effect is the judgment of P. W. Litchfield, author of a penetrating analysis of today's industrial relations which he calls "The Industrial Republic—Reflections of an Industrial Lieutenant."

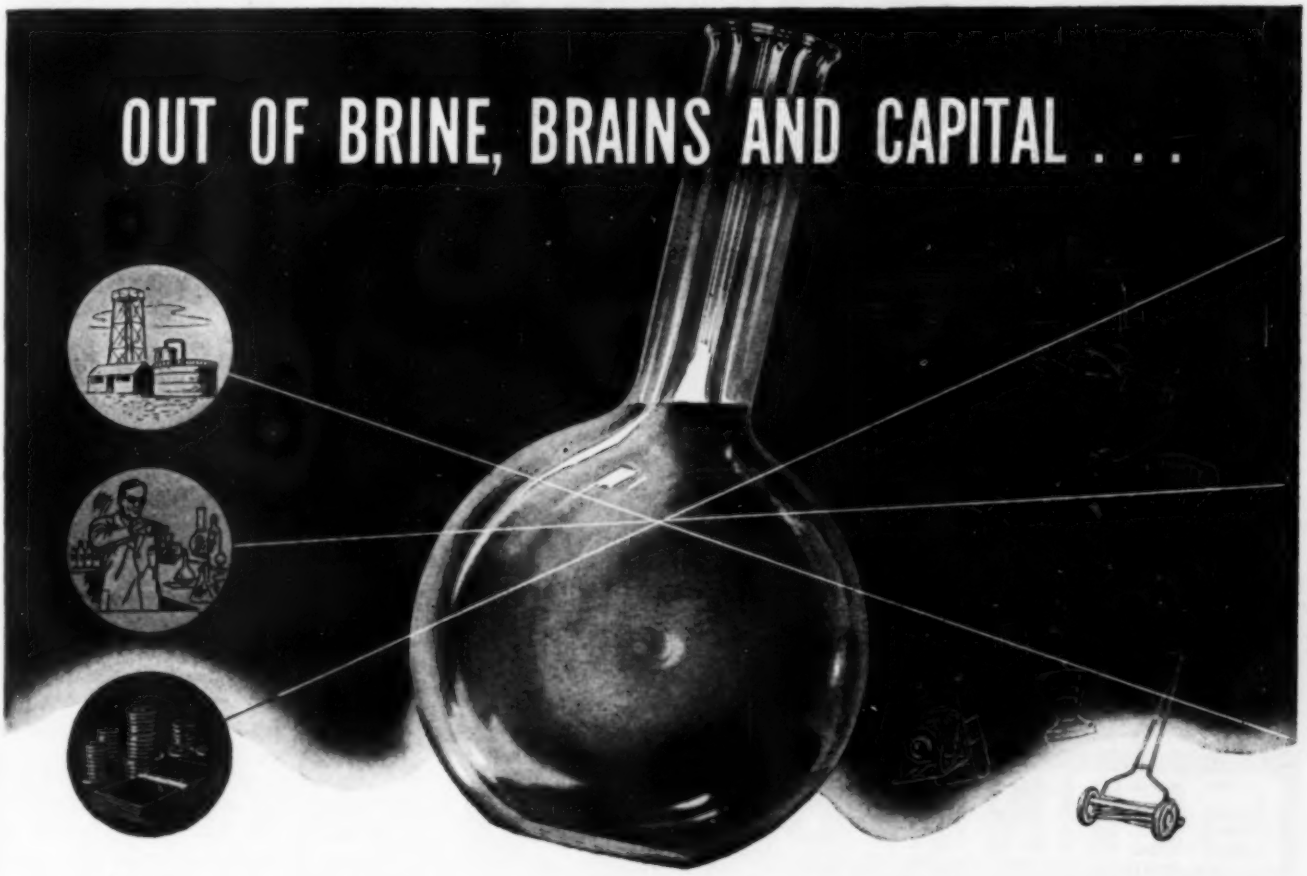
"Labor," says Mr. Litchfield, "should assume fuller responsibilities. . . It should stop causing a constant state of disorder as common practice, remove the communist influence and more truly represent the best interests of the entire membership.

"Employers should. . . recognize that the principle of unionization. . . is here to stay. . . They should guard against unbalance in the distribution of profits, and they should undertake to know about materials, markets and methods. They should quit being afraid of demagogues in labor or in government and speak out in a direct and frank manner.

"The public should take its stand

One of a series of advertisements showing the importance to American industry of the underwriting and distribution of investment securities.

OUT OF BRINE, BRAINS AND CAPITAL . . .



a Company Serving Innumerable Human Needs

From a small producer of bromine in 1889 the Dow Chemical Company has become one of the nation's largest producers of chemicals. Today Dow products number in the hundreds, serve innumerable human needs.

Good management, continuing research and sound financing were required for that growth and diversification. In the development of its financial program, Smith, Barney & Co. has long assisted Dow Chemical Company through underwriting and distributing securities to provide the capital essential for Dow's progress and expansion.

The beginning

Brine of unusual bitterness underlies a large area near Midland, Michigan. To the salt maker of 1889 it was too full of impurities for salt-making. But to a youthful chemist of that day, Herbert H. Dow, it was the raw material needed for his new process for recovering bromines from saline solutions. He built a tiny plant—and founded the now famous Dow Chemical Company.

The brine wells still flow . . .

. . . and brine is still the important basic raw material of Dow Chemical Company—now directed by the founder's son, Dr. Willard H. Dow, eminent scientist and administrator. Today the original few products of 1889 are myriad as persistent research sweeps back chemical frontiers: chlorine for organic chemicals, bromides for photography and for knockless gasoline, chlorinated hydrocarbons for solvents, magnesium for light-weight products, calcium chloride for dustless roads and dustless coal, plastics—these are but a few. New products are being constantly added in the many Dow plants and laboratories located throughout the country.

Growth implemented by capital

Capital has been required for the expansion of Dow Chemical Company from its small beginnings to its present position in the chemical field. To provide capital, Smith, Barney & Co. since 1936 has underwritten no less than six issues of Dow securities. These have provided funds for growth and for redemption, with savings to the company, of outstanding securities.

From this combination of brine, brains and capital much has been created—Dow provides directly more than 13,000 jobs—products of Dow have been the basis for creation of many new industries, as well as the expansion of older ones, indirectly making countless other jobs to help build a better America. Of immeasurable value are the resulting contributions to society through products that have enriched our daily living and done much to help this nation progress to the world's highest standard of living.

Advantages to you

The advantages derived from the relationship between Dow Chemical Company and Smith, Barney & Co. have been duplicated many times in the long history of this firm, and its antecedent firms. We are prepared to render equally valuable service to others. To tell you more of the facilities provided by our firm, we have prepared a booklet entitled "*What Smith, Barney & Co. Offers You.*" A copy may be obtained on request to Smith, Barney & Co., 14 Wall Street, New York 5, N. Y., Department AH.

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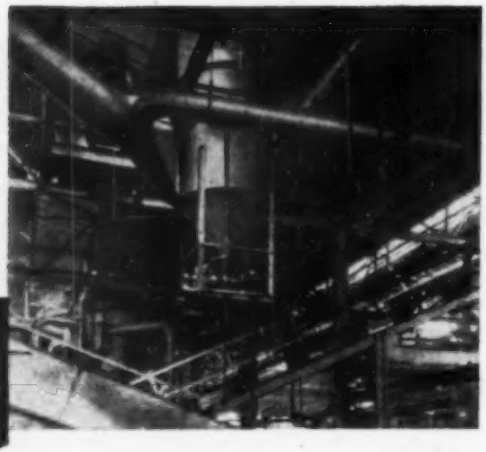

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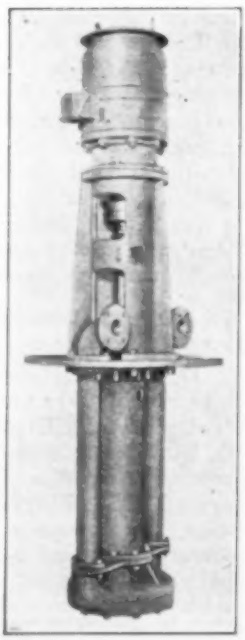

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LAWRENCE CENTRIFUGALS
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against excesses committed under any guise. It should insist upon equal stature for all parties to industrial disputes in the eyes of the law. It should reject the doctrine of rabbits-out-of-hats and return to the principles of work, thrift and fair play."

The author is overly modest in characterizing himself as "an industrial lieutenant." With half a century of industrial experience behind him, much of it spent as executive head of Goodyear, the term "industrial general" would be more accurate. Mr. Litchfield has recorded in the brief compass of several hundred pages a case history of industrial relations—that of the Goodyear company—as well as a general text on the subject. And as might be expected from a writer of such broad practical experience, the book is studded with pithy economic observations of which the following are examples:

"...more and more people are doing a poor day's work and at the same time asking for more money.

"Records kept for many years by private sources and by government prove that if it were possible to add *all* the net profits of manufacturing industries to wages the increase would amount to less than 10 percent. Therefore, so far as the average business house is concerned, drastic wage increases mean increased selling cost because profits are not sufficient to absorb the increased cost.

"Too much increase in the general wage level, without increased productivity, leads to inflation, and does not benefit the worker or the consumer, for in that case the cost of living will rise in substantially the same proportion as wages. This is inevitable in view of the fact that the greater percentage of the cost of manufactured articles is in the form of wages, when figured through all the stages from raw materials to making the finished product available to the customer."

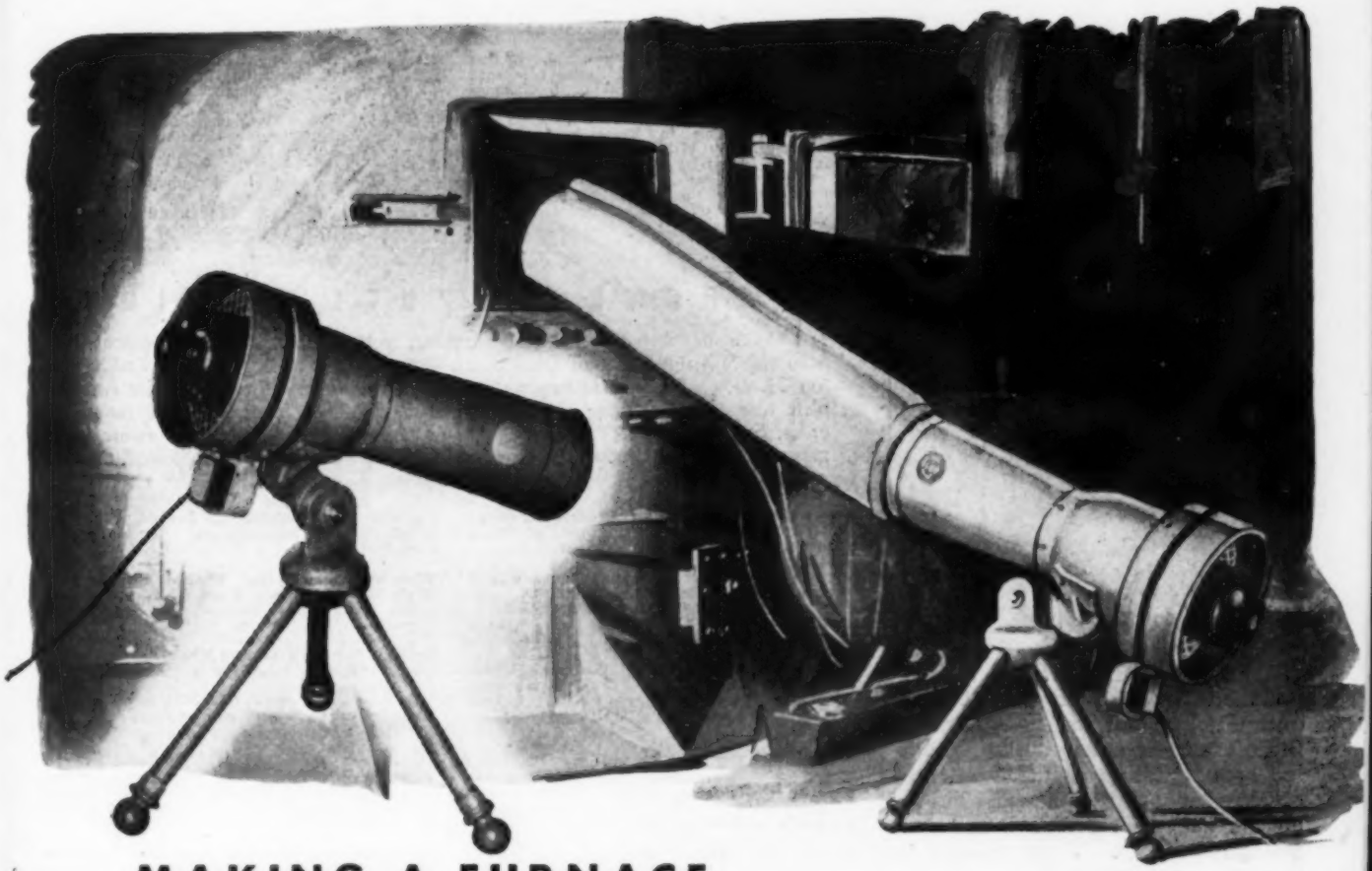
This last of course is a direct refutation of the type of economic quackery preached by certain labor leaders and which events of the past year and a half have likewise proved utterly false.

RECENT BOOKS and PAMPHLETS

Galvanizing Handbook. By J. R. Daesen. Published by Reinhold Publishing Corp., 330 West 42nd St., New York 18, N. Y. 166 pages, $5.25. Basic principles. Nature and cause of many defects encountered in consulting practice.

The Steel and Steel-Using Industries of California. By E. T. Grether. Available from Printing Division, 11th and O sts., Sacramento 14, Calif. 408 pages. $1.50. Prewar developments, wartime adjustments, and long-run outlook.

Directory of Biological Laboratories. Third edition. Published by Burns Compiling & Research Organization, 200 Railway Exchange



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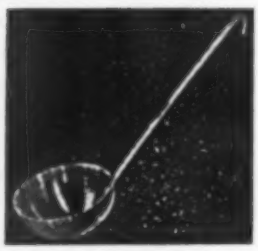

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Bldg., Chicago 4, Ill. 177 pages. $3. Listing of laboratories in the United States concerned with biological, bacteriological or biochemical investigations.

Human Relations in Research Institution Management. By William A. Hamor, Mellon Institute of Industrial Research, Pittsburgh 13, Pa. 10 pages. Gratis. Experience in management of possible suggestive use research directors and executives. Reprinted from "Advanced Management."

The Pharmaceutical Industry. By Robert A. Hardt. Published by Bellman Publishing Co., 83 Newbury St., Boston 16, Mass. 32 pages. $1. Monograph for guidance activities.

National Electrical Code. Published by National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass. 408 pages. $2. Rules governing installation and, to a certain extent, the use of electrical equipment.

Resistance Welding Manual. Published by Resistance Welder Manufacturers Association, 505 Arch St., Philadelphia 6, Pa. 552 pages. $3. Revised edition.

GOVERNMENT PUBLICATIONS

The following recently issued documents are available at prices indicated from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. In ordering any publications noted in this list always give complete title and the issuing office. Remittance should be made by postal money order, coupons, or check. Do not send postage stamps. All publications are in paper cover unless otherwise specified. When no price is indicated, the pamphlet is free and should be ordered from the bureau responsible for its issue.

International Control of Atomic Energy: Growth of a Policy. Department of State Publication 2702. Price 45 cents.

Apparatus for Determining Water-Vapor Permeability of Moisture Barriers. By Frederick T. Carson and Vernon Worthington. National Bureau of Standards Circular C453. Price 10 cents.

Concrete and Reinforced Concrete. National Bureau of Standards, Letter Circular LC-838. Mimeographed. Publications by Bureau staff and list of Federal Specifications.

Glass and Glass Products. National Bureau of Standards, Letter Circular LC-841. Mimeographed. Publications by Bureau staff and list of Federal Specifications and Standard Samples.

Dental Materials. National Bureau of Standards, Letter Circular LC-839. Mimeographed. Publications by Bureau staff and Research Associates.

List of Commercial Standards. National Bureau of Standards, Letter Circular LC-842. Mimeographed. Revised to Jan. 1, 1947.

Weights per United States Gallon and Weights per Cubic Foot of Sugar Solutions. National Bureau of Standards, Circular C457. Price 10 cents.

Guides for New World Traders. Department of Commerce, Economic Series No. 59. Price 10 cents.

Trends in Urban Wage Rates. Bureau of Labor Statistics, Bulletin No. 891. Price 5 cents.

Aluminum Plants and Facilities. First Supplementary Report of War Assets Administration to Congress, Feb. 12, 1947. Price 25 cents.

Directory of Electric and Gas Utilities in the United States—1946. Federal Power Commission. Price $5. Buckram.

Annual Report of the Commissioner of Internal Revenue, Fiscal Year Ended

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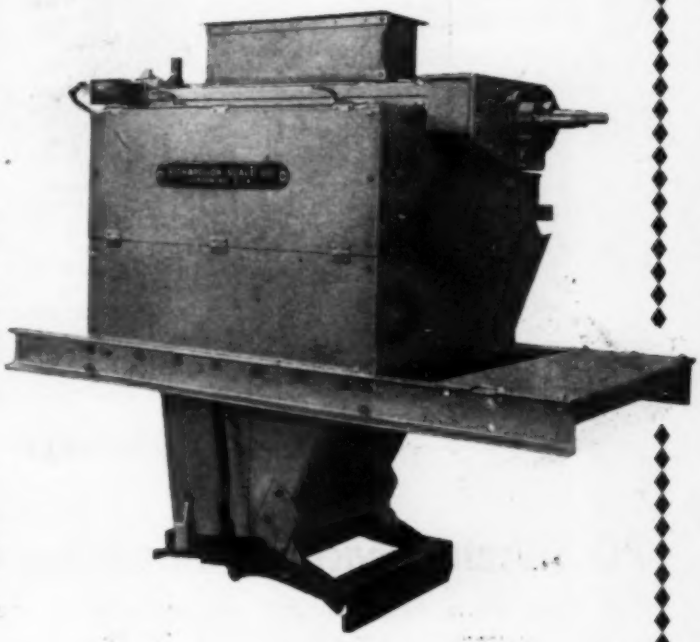

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PQ SILICATES OF SODA

June 30, 1946. Price 40 cents. Contains annual alcohol tables.

Statistics of Land-Grant Colleges and Universities, Year Ended June 30, 1944. U. S. Office of Education, Bulletin 1946—No. 16. Price 10 cents.

Geologic Features of the Connecticut Valley, Mass., as Related to Recent Floods. By Richard H. Jahns. Geological Survey Water-Supply Paper 996. Price $1.75.

Fluorspar Deposits Near Duncan, Arizona. Preliminary Maps 3-207, Strategic Minerals Investigations Series. By Robert D. Trace. Available free on request to Geological Survey, Washington 25, D. C.

Summary of Information on the Durability of Woodworking Glues. By F. F. Wangaard. Available only from Forest Products Laboratory, Madison, Wis. No. 1530. Mimeographed.

Exhibit Pictures From the Four Regional Research Laboratories. Department of Agriculture, Miscellaneous Publication No. 617. Price 25 cents.

Trade Agreement Digests. U. S. Tariff Commission. A supplementary list for use in trade agreement negotiations. March 1947. Mimeographed.

Production Outlook 1947. Office of Temporary Controls, Civilian Production Administration. February 1947. Processed.

United States Government Manual. Bureau of the Budget. Price $1.

Federal Specifications. New or revised specifications which make up Federal Standard Stock Catalog have been issued on the following items: Paper: Mimeograph UU-P-388c. Paper: Index UU-P-258b. Belting: Flat, Leather, Vegetable-Tanned KK-B-201b. Burners; Alcohol, Pressure-Type GG-B-814. Drums; Steel, I.C.C. Types 17C and 17E 5-Gallon, Single-Trip-Container RR-D-760. Pails; Steel, I.C.C. Type 37D, 5-Gallon, Single Trip-Container RR-P-45. Paint; Ready-Mixed, Exterior, Chrome-Green TT-P-71b. Cellulose Acetate; Strip, Dental L-C-201. Price 5 cents each.

Low-Temperature Coke by the Krupp-Lurgi Process. By L. D. Schmidt. Bureau of Mines, Information Circular I.C. 7395. Mimeographed.

Coking Coal Deposits on Lookout Mountain, DeKalb and Cherokee Counties, Ala. By D. M. Coulter. Bureau of Mines, Report of Investigations R. I. 4030. Mimeographed.

Terlingua Mercury Deposit, Brewster and Presidio Counties, Texas. By A. M. Evans and W. M. Traver, Jr. Bureau of Mines, Report of Investigations R. I. 3995. Mimeographed.

Blackbird Cobalt Deposits, Lemhi County, Idaho. By G. C. Reed and J. A. Herdlick. Bureau of Mines, Report of Investigations R. I. 4012. Mimeographed.

Celestite Deposits, Brown, Nolan, Fisher, and Coke Counties, Texas. By W. E. Dennis, et al. Bureau of Mines, Report of Investigations R. I. 4018. Mimeographed.

Texas Mica and Feldspar Co., Culbertson and Hudspeth Counties, Texas. By S. P. Holt and J. A. Bowsher. Bureau of Mines, Report of Investigations R. I. 4009. Mimeographed.

Exploration of Fluorite Ridge Fluorspar District, Luna County, N. Mex. By Paul L. Russell. Bureau of Mines, Report of Investigations R. I. 3987. Mimeographed.

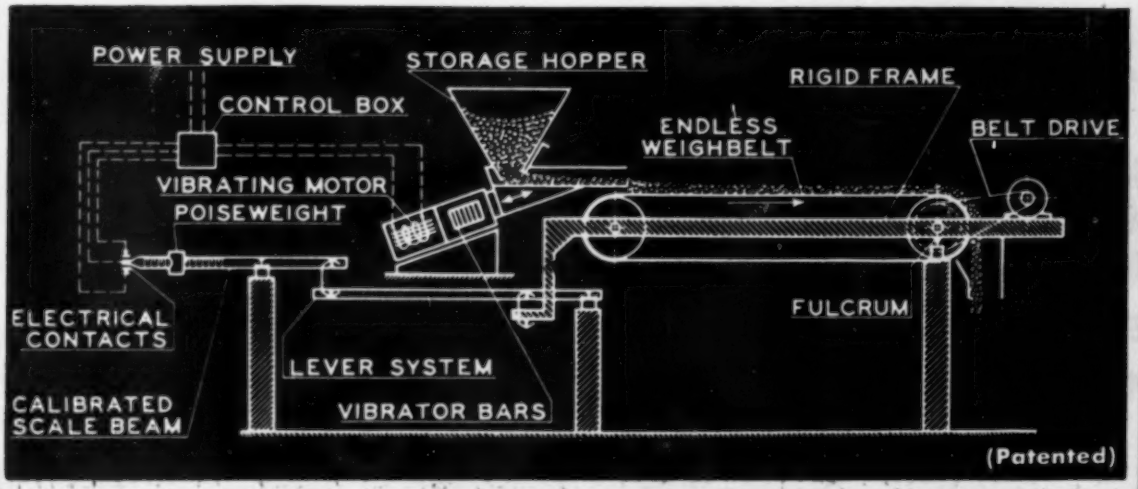
Fluorite on the Lee Mine Property, Hardin County, Illinois. By O. M. Bishop. Bureau of Mines, Report of Investigations R. I. 3996. Mimeographed.

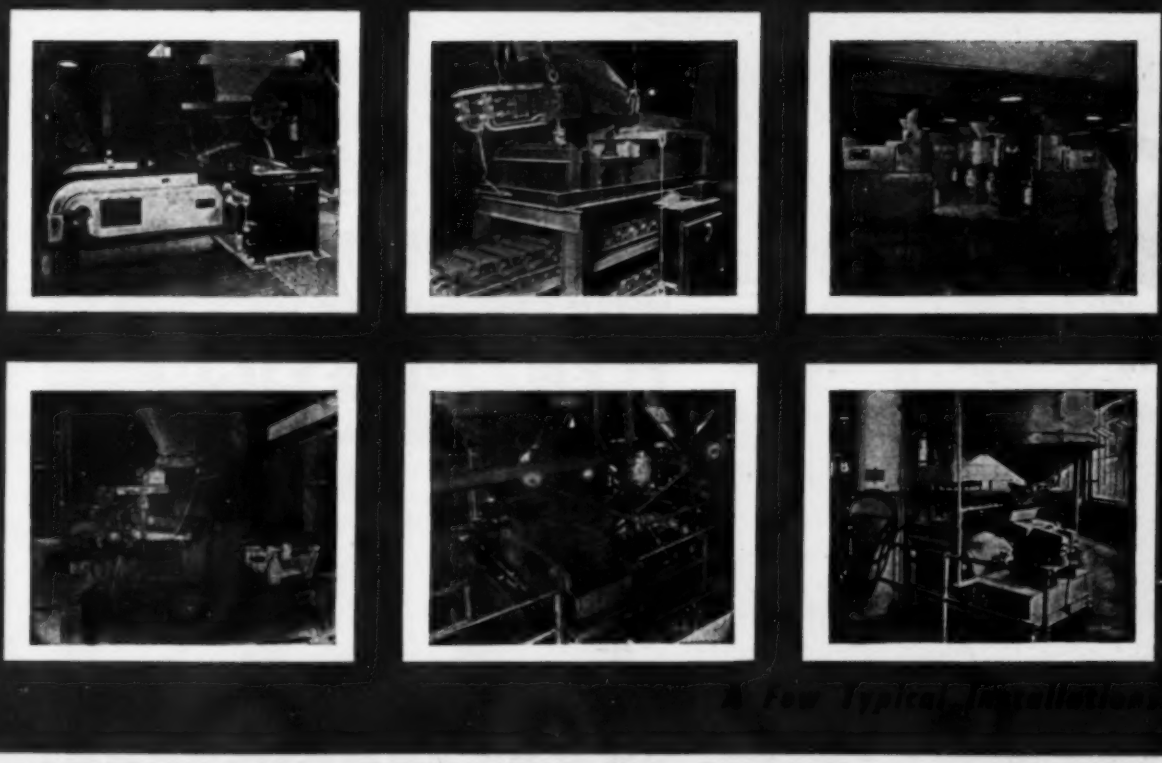
Valery Fluorspar Deposit, Pershing County, Nevada. By Victor E. Kral. Bureau of Mines, Report of Investigations R. I. 4014. Mimeographed.

United States Fluorspar Co. Property, Sierra County, N. Mex. By M. J. Sheridan. Bureau of Mines, Report of Investigations R. I. 4017. Mimeographed.

Gila Fluorspar District, Grant County, N. Mex. By Paul L. Russell. Bureau of Mines, Report of Investigations R. I. 4020. Mimeographed.

JEFFREY TRAYLOR WAYTROLS





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MANUFACTURERS' LATEST PUBLICATIONS

Chemical Engineering's Readers' Service, in cooperation with manufacturers, makes it possible for you to secure catalogs, bulletins, and other publications herein listed without obligation (unless a price is specifically mentioned). For your convenience, publications may be obtained by using Reader Service Coupons on pp. 157-158.

(Continued from page 158)

110. Pumps. Byron Jackson Co., Los Angeles, Calif.—Bulletin No. 46-5000 contains 12 pages illustrating and describing the deep well submersible turbine pumps made by this company. Cutaway views show principles of operation. Bulletin No. 46-6000. 12-page booklet describing the Hydropress pump made by this company. Details of construction are illustrated.

111. Caustic Soda. Columbia Chemical Division, Pittsburgh Plate Glass Co., Pittsburgh, Pa.—72-page booklet discusses methods of manufacture, purification processes, uses and functions, forms and grades of this company's caustic soda, methods of handling and unloading. Flow diagrams for the different manufacturing processes are shown and the book is profusely illustrated with photographs of these processes, as well as many application processes. The section on methods of handling and unloading is particularly well handled. The booklet contains a technical data section which gives properties, methods of analysis, and contains a number of charts giving physical properties of caustic soda solution. This plastic bound booklet is an exceptionally worthwhile treatment which should be worthwhile to the users of this product.

112. Refractories. Norton Co., Worcester, Mass.—22-page booklet illustrating and describing the heavy duty refractories made by this company. Contains information on the selection and specification of refractories together with rather complete descriptions of the products made by this company. Contains a number of charts, tables and curves giving properties and characteristics of these products. Catalog R-1Q.

113. Instruments. Bailey Meter Co., Cleveland, Ohio—4-page booklet No. 1022 features control systems for spreader stokers. Illustrates and explains the operation of standardized component parts of the control system. Also shown are chart records illustrating the performance of a complete system with automatic fuel-air ratio control.

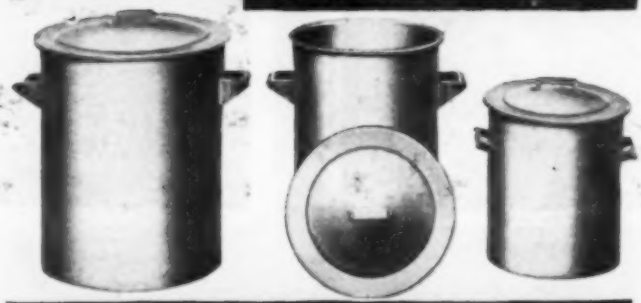
114. Couplings. John Waldron Corp., New Brunswick, N. J.—4-page leaflet featuring the flexible couplings available from this company. Features of construction are shown by cutaway views and diagrammatic sketches.

115. Chemicals. American Cyanamid Co., New York, N. Y.—18-page booklet discusses the organic nitrogen chemicals available from this company. Contains a two-page chart which outlines the group of organic nitrogen compounds now available or soon to become available from this company. These chemicals are all derivatives of either hydrogen cyanide, cyanogen chloride, or dicyandiamide. A number of the more important chemical reactions are given.

116. Safety Equipment. Mine Safety Appliances Co., Pittsburgh, Pa.—4-page folder featuring the Chemox self-generating oxygen breathing apparatus available from this company. The operating principles are illustrated and described.

117. Pumps. The Bell & Gosset Co., Morton Grove, Ill.—Bulletin 6B-1241. A 4-page leaflet featuring a booster pump made by this company. This pump can be installed in six different kinds of

Help for your
CHEMICAL STORAGE and PROCESSING PROBLEMS •



STAINLESS STEEL
STOCK POTS

• Solve many of your storage and processing problems with these rust-proof, acid-resisting, easy-to-clean Stock Pots.

Made throughout of 16 gauge, 18-8 Stainless Steel welded construction, with all inside welds ground smooth and polished.

SPECIAL EQUIPMENT

These pots can be purchased with or without covers and if desired can be fitted with casters to make them portable.

Write for complete specifications and prices.

We also manufacture a complete line of Storage Tanks and Equipment.

METAL GLASS PRODUCTS CO. BELDING, MICH. DEPT. C

It's a "Cost-Compressor," too!

The Worthington YC Saves You Money In Every Detail of Installation and Operation

Installation Savings

- Takes ½ the building space and ¼ the foundation space of same capacity horizontals.
- Comes assembled; needs no alignment, special clamps or erecting engineer.
- Needs only power and air connections to put it to work.
- Quickly and easily installed, even where subsoil is poor.
- Lighter weight reduces transportation charges.

Operation Savings

- Perfectly balanced Y-frame for higher rpm cuts motor costs.
- Specially designed bearings and rods eliminate ordinary wedge-adjustments.
- Outside valves, large openings, easy-to-reach parts allow quick inspection.
- Spare parts smaller and less expensive.
- Worthington Feather* Valves are the lightest, most efficient, most economical ever made.

Another big advantage of YC's is their adaptability to many drives — Multi-V-Drive, coupled drive from explosion-proof motor, steam turbine, or practically any type of rotative power. Still another is the instantly responsive, power-saving, 3- and 5-step *variable capacity control* . . . From start to finish you'll pay less for air with these rugged, long-lived, cooler and smoother running Worthington YC Compressors.

Write for Literature

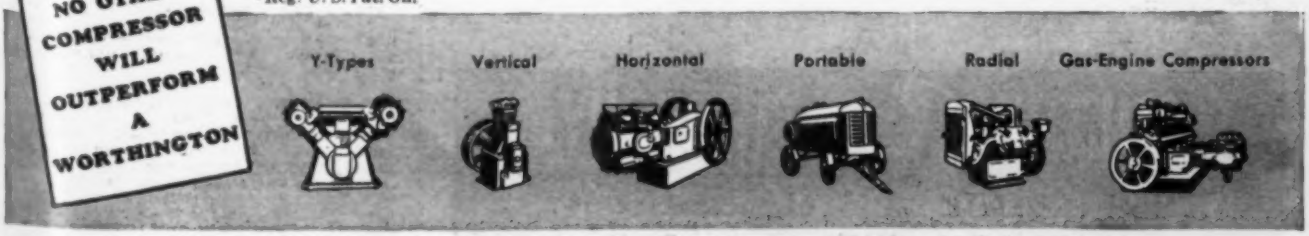
Bulletin L-667-B1A will give you the whole story . . . and further proof that *there's more worth in Worthington. Worthington Pump and Machinery Corporation, Compressor Division, Buffalo, New York.*

WORTHINGTON

NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON

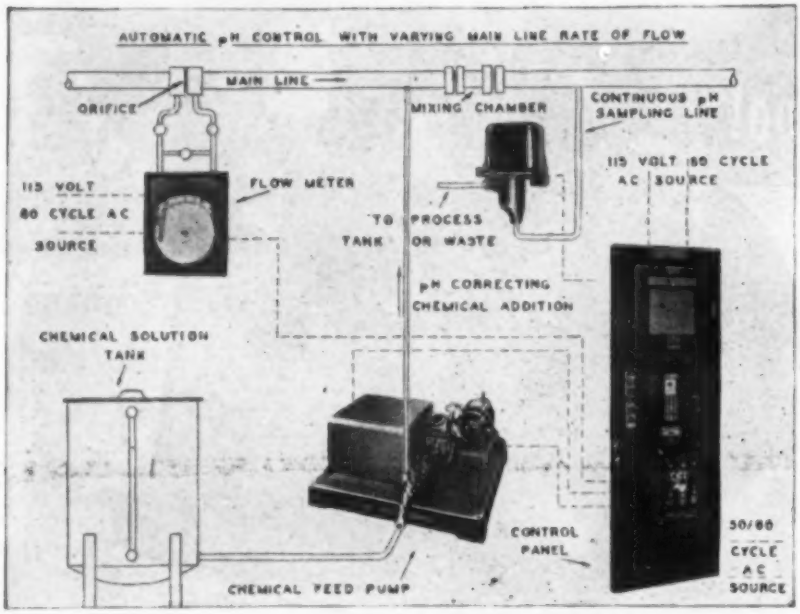
*Reg. U. S. Pat. Off.

K7-8



Automatic pH CONTROL

with Varying Main Line Rate of Flow



Milton Roy Pumps are controlled volume metering units, designed to meter and pump practically any liquid in volumes as low as 1 pint per hour to as high as 23 gallons per minute per pump side and against pressures as high as 20,000 lbs. per square inch. Because of the high degree of accuracy of volumetric measure made possible by the Milton Roy step valve design, these pumps have found many applications as components of automatic chemical feed systems.

In the system shown, for example, the capacity of the Milton Roy pump is automatically compensated for two variables — rate of flow and pH value. Pump motor speed is directly proportional to rate of main line flow and length of stroke of the pump is automatically adjusted by the pH controller. Thus the pH controller is only required to follow changes in chemical characteristics of the system, eliminating "hunting" and resulting in uniform pH correction.

The necessity for constant and automatic pH control is well recognized in many applications including water treatment, pharmaceutical manufacture, paper making and chemical processing.

The many automatic pH control systems designed by Milton Roy and now in successful operation demonstrate the suitability of Milton Roy equipment for these applications.

For further details on pH control equipment and other automatic Milton Roy Chemical Feed Systems for various applications write for Bulletin 468 and Technical Paper No. 54 "An Application of Electronics in Automatic Chemical Feed Systems."

MILTON Roy COMPANY

1322 E. MERMAID AVE., CHESTNUT HILL, PHILA., 18, PA.

positions. It is used for forced hot water heating systems and for circulating service water systems.

118. Peroxide Bleaching Processes. E. I. du Pont de Nemours & Co., Wilmington, Del.—24-page illustrated booklet describing the continuous peroxide bleaching processes for use in the textile industry. The various pieces of equipment used in the process are illustrated and described. Several flow diagrams are used to illustrate features of the process. Also an 8-page booklet describing peroxide bleaching of groundwood pulp. Features of the process are discussed and different types of systems are illustrated by flow diagrams.

119. Water Treating. The Cochrane Corp., Philadelphia, Pa. — Publication 3000.—68-page bulletin describing hot-process water softeners for removal of hardness, corrosion gases, silica and other scale forming material from boiler feed and industrial process waters. The proper treatment for various water conditions is discussed. Contains flow diagrams, construction drawings, together with schematic diagrams of various types of installations. Silica removal, sludge recirculation, automatic desludging, and other operations are described. Contains a 9-page appendix of feedwater chemistry. It is well illustrated with photographs of the various types of equipment and includes cutaway views of the equipment which show details of operation.

120. Materials Handling. Speedways Conveyors, Buffalo, N. Y.—2-page leaflet featuring the 45 deg. Flipswitch for connecting a spur line on the standard gravity type roller conveyors made by this company. It makes it possible to divert the flow of materials from a main conveyor line to the spur in a continuous flow without stopping and starting materials or without transferring cases, boxes, crates, etc., from one line to another.

121. Chemicals. Ansul Chemical Co., Marinette, Wis.—5-page bulletin entitled "Methylation With Methyl Chloride." Contains a general procedure for methylation with methyl chloride, including a detail drawing of the necessary apparatus for laboratory use.

122. Bearings. Miniature Precision Bearings, Keene, N. H.—Bulletin 4b-1. 4-page folder illustrating and describing the miniature ball bearings made by this company. Actual sizes of the bearings are shown pictorially and specifications and dimensions are given.

123. Equipment. The Darby Corp., Kansas City, Kan.—2-page leaflet illustrating corrosion resistant equipment such as stainless steel mixing tanks, nickel clad steel reaction vessels, storage tanks, etc.

124. Couplings. Industrial Machine Works, Inc., South Hanover, Mass.—4-page folder featuring the flexible couplings made by this company. Construction features are shown. Contains a table of specifications and dimensions for the various sizes of gear-tooth flexible couplings.

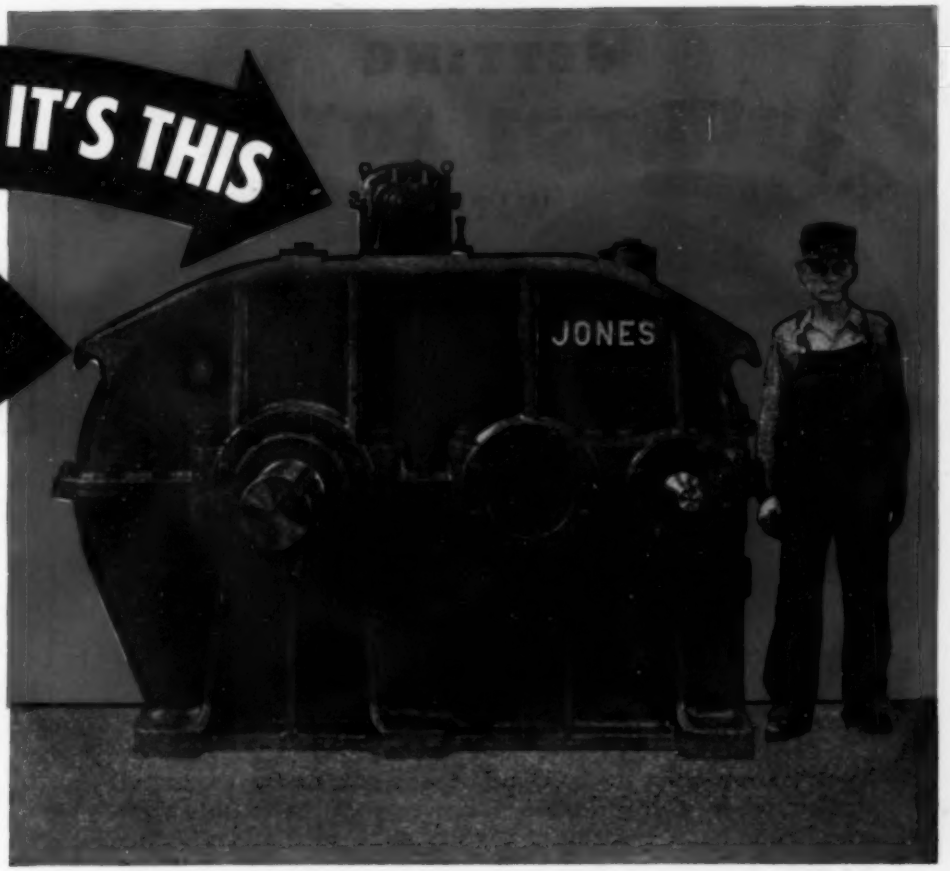
125. Magnetic Pulleys. Magnetic Engineering & Mfg. Co., Clifton, N. J.—Catalog No. 146 contains 12 pages illustrating and describing the Memco high power magnetic pulleys made by this company. Operation and application of both the air cooled and solid pulleys are described and illustrated. Design and construction details are tabulated as are the weights, capacities, dimensions, etc.

126. Alloys. Ampco Metal, Inc., Milwaukee, Wis.—4-page bulletin No. 57A describes the different applications of this company's alloys in machine tool parts.

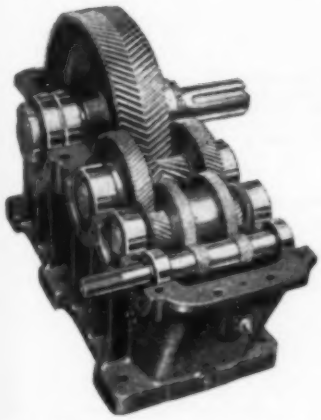
127. Instruments. Taber Instrument Corp., North Tonawanda, N. Y.—Bulletin 4506 features the Taber V-5 stiffness gage used in the precision measurement of stiffness and resilient qualities of materials.

128. Solvents. Carbide & Carbon Chemicals Corp., New York, N. Y.—24-page booklet, Form 4765, entitled "Cellosolve and Carbitol Solvents," presents in detail the important properties, specifications, uses and constant boiling mixtures of nine glycol-ethers. In chart form it gives such information as physical constants, comparative evaporation rates,

WHETHER IT'S THIS —OR THIS



. . . both are designed and constructed to give satisfactory service and long life



The above view of a Jones Triple Reduction Herringbone Speed Reducer is typical of a line that is noted for advanced design, superior materials, precision workmanship.

TWENTY FOUR hours a day operation plus loading up to rated capacity or beyond are testing speed reducers in every type of service.

Jones Herringbone Speed Reducers are establishing remarkable service records under these conditions. One reason of course is the fact that Jones Reducers have always been rated in accordance with the recommended practice of the American Gear Manufacturers Association.

With this conservative rating policy goes sturdiness, compactness, symmetry and balance—all factors that influence maximum efficiency, long life and improved performance.

Jones Herringbone Gear Speed Reducers are built in a wide range of ratios and ratings to cover every requirement. Single (Type SH) reducers in standard ratios range from 1.25 to 1 up to 11 to 1 in ratings from 1.3 to 440 H.P. Double (Type DH) reducers are built in standard ratios from 10.9 to 1 up to 72 to 1 in ratings from 0.5 to 275 H.P. The triple reduction reducers (Type TH) cover a range of ratios from 86.9 to 1 up to 355.8 to 1 in ratings from 0.3 to 78 H.P.

All these reducers have heat treated gears, ground shafts and are mounted with anti-friction bearings throughout. Cast iron bases are available for all variations of motor assembly.

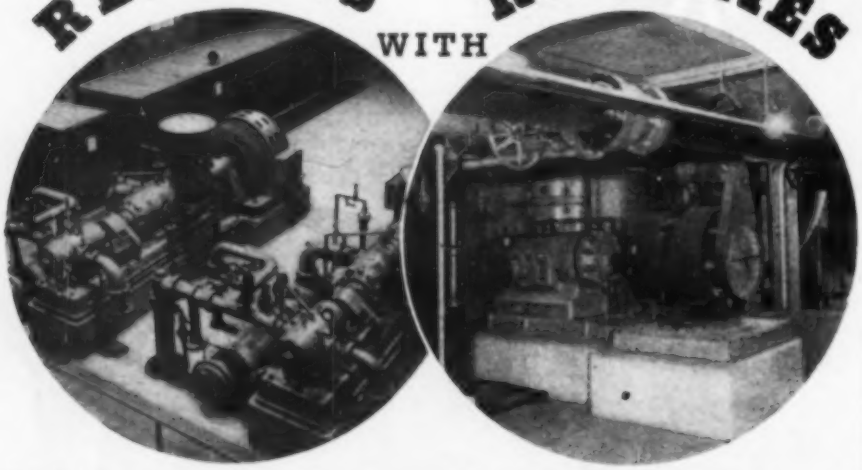
For complete information on both standard and special applications of Jones Herringbone Reducers ask for Catalog No. 70. This 128 page catalog is a comprehensive technical treatise on the whole subject of Herringbone Reducer application for all conditions of service. If you have any type of drive problem that might call for Herringbone gears we shall be pleased to send you a copy.

W. A. JONES FOUNDRY & MACHINE CO., 4415 Roosevelt Road, Chicago 24, Ill.

Jones

HERRINGBONE—WORM—SPUR—GEAR SPEED REDUCERS • PULLEYS • GEARS • V-BELT SHEAVES • ANTI-FRICTION PILLOW BLOCKS • FRICTION CLUTCHES • FLEXIBLE COUPLINGS

GETTING RESULTS WITH ROTARIES

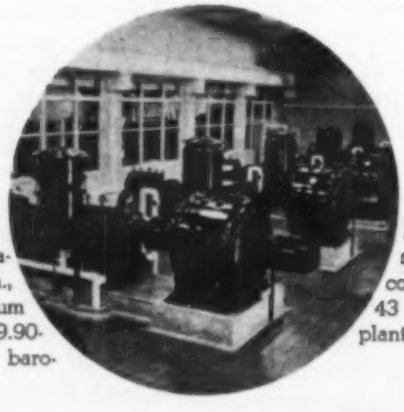


Two Fuller Rotary Two-stage Compressors in a steel mill. Twenty eight Fullers have been installed by this company.

Fuller Rotary Single-stage Compressor in a cement plant. This company has 20 Fullers in operation in its plants.

Many companies have found it good business to install Fuller Rotary Compressors wherever possible to do so. In fact, some have practically standardized on Fullers. Once a Fuller is installed, and additional air capacity is required, more Fullers are purchased and installed. Repeat orders are very common and comprise a large percentage of our compressor business.

There are many sound reasons for this popularity and demand. If you are not familiar with these machines, may we urge you to take the time to investigate the many outstanding features of Fuller Rotaries.



Fuller Rotary Compressors are built for capacities to 3300 c.f.m., 125-lb. pressure. Vacuum Pumps for vacuums to 29.90-in. (referred to 30-in. barometer).

Five Fuller Rotary Two-stage Compressors. This company has purchased 43 Fullers for its various plants.

FULLER COMPANY, CATASAUQUA, PA.

Chicago 3 · 120 So. LaSalle St.
San Francisco 4 · 421 Chancery Bldg.
Washington 5, D. C. · 618 Colorado Bldg.

C-195

FULLER

A LIFETIME OF NEW MACHINE EFFICIENCY

and various solubilities. Also includes a number of references on this subject in the technical literature.

129. Rubber Development. B. F. Goodrich Co., Akron, Ohio—28-page booklet showing typical examples of development in rubber and Koroseal comprises a collection of case history advertisements which have appeared during recent months.

FOR MORE INFORMATION

See Reader Service Coupon on pages 157-158

130. Materials Handling. Lyon - Raymond Corp., Greene, N. Y.—Bulletin 221 is a 2-page leaflet featuring the light weight, streamlined hydraulic pallet lift truck made by this company.

131. Furnaces. Heavi-Duty Electric Co., Milwaukee, Wis.—Bulletin HD1246 contains 4 pages describing the multiple unit crucible furnaces made by this company. The different types of furnaces are illustrated and specifications are given in tabular form.

132. Carbon Black. Witco Chemical Co., New York, N. Y.—7-page mimeographed technical service report No. R-3 contains technical data on this company's carbon black "Continex HNF". Contains graphs and bar charts which compare this product with other carbon blacks. Comparative test values are tabulated for tensile strength, elongation, abrasion loss, and other properties.

133. Safety Equipment. B. F. Goodrich Co., Akron, Ohio—Catalog section 9035 contains 4 pages describing the industrial rubber gloves for resisting oils, acids, greases, etc.

134. Instruments. Fischer & Porter Co., Hatboro, Pa.—Catalog section 27-A contains 12 pages of dimension drawings for Series 700 Flowrator instruments made by this company. Dimensions are tabulated for the various models and variations of this series of instruments.

35. Sealing Compound. Aeroil Products Co., West New York, N. J.—Bulletin No. 310 is an 8-page leaflet featuring the equipment for heating and melting of rubberized asphalt joint sealing compound. Details of the equipment are illustrated and described.

136. Pumps. Sier-Bath Gear & Pump Co., North Bergen, N. J.—New catalog illustrates and describes this company's Gearex rotary pumps. Features of the pumps are illustrated and described and a number of applications are discussed in detail.

137. Protective Coatings. Prufcoat Laboratories, Inc., Cambridge, Mass.—2-page leaflet giving instructions in detail for applying prufcoat to various types of surfaces.

138. Materials Handling. Frank G. Hough Co., Libertyville, Ill.—Bulletin No. 162 contains 8 pages illustrating and describing the Model HA tractor shovel made by this company. Detailed specifications are given and a number of applications are illustrated. Bulletin No. 163 is an 8-page booklet featuring Model HL-A-Gas and Model HLD-A-Diesel tractor shovels made by this company. Features of construction are illustrated and specifications are included. Various applications are shown. Bulletin No. 164. 8-page folder illustrating and describing the Model 9-A bulldozer-shovel.

139. Gears. Mica Insulator Co., Schenectady, N. Y.—Booklet describes how to make gears with Lamicoid, a laminated phenolic plastic. Discusses applications for these gears and contains tables giving preferred torques, safe working stresses and other practical information.

140. Filling Machines. F. J. Stokes Machine Co., Philadelphia, Pa.—24-page catalog No. 908-A illustrating and describing the filling, closing and sealing machines made by this company. Each model is described in detail and the construction details shown pictorially.

CHEMICAL ECONOMICS

H. M. Ballers, MARKET EDITOR

Activities in Chemical-Consuming Industries Have Exceeded Earlier Expectations

In the final quarter of last year, a rising trend was reported in the chemical industry and forecasts for the first quarter of 1947 generally held that the rising line for production would continue. As the year advanced and data regarding activities became available, it was found that earlier expectations not only had been realized but had been considerably exceeded. The preliminary figure of the Federal Reserve Board placed production of industrial chemicals in January at 425 but that figure has been revised to 430 and the preliminary figure for February has been set at 435 with March apparently destined to make an equally favorable showing. Hence the January-March period has established production of chemicals at a level about 12 percent above that of the comparable months of 1946 and well ahead of that for any previous quarter in the history of the industry.

A sharp upward revision also has been made in the *Chemical Engineering* index for consumption of chemicals in January with the number standing at 225.63 as compared with 192.92 for January of last year. For February, some of the data are preliminary but they indicate that transportation difficulties and the shorter working period brought the consumption index down to 209.59. Weather conditions in several parts of the country in February slowed the movement of raw materials and finished products and forced some curtailment in plant activities. Shortage of tanks and boxcars has been in evidence for some time and undoubtedly the production record actually made could have been bettered had the transportation situation been more favorable.

While some of the large additions to capacity, such as that for soda ash, will take some months to complete, the rising trend for chemical production is due in part to the bringing into operation of new units which in the aggregate help considerably in increasing the variety and volume of output.

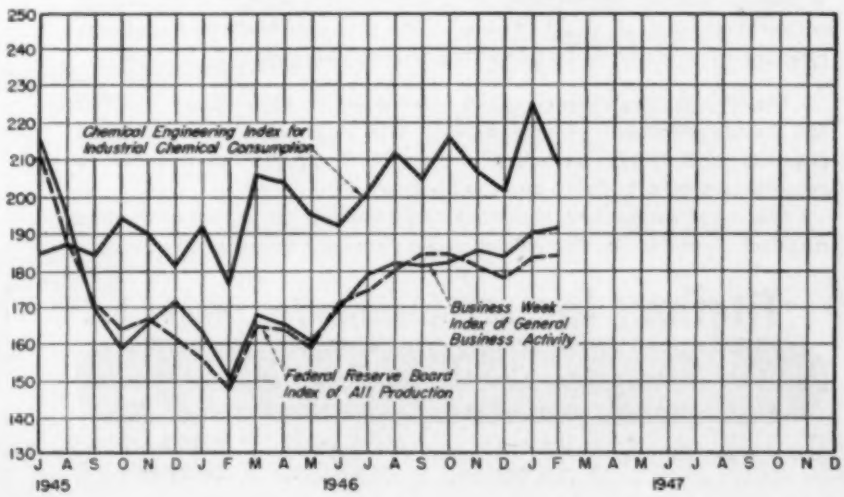
While recent expansion in production has been accompanied by a rise in stocks, inventories of chemicals are not unduly large and are said to consist largely of materials in process. A continued high volume of output, however, is contingent upon a receptive consuming market and in this respect encouragement is found in the improved position of most of the large manufacturing lines for which chemicals are important raw materials. Fertilizer manufacturers do not use as wide a variety of chemicals as some other industries but their tonnage requirements top those of any other industry group. Demand for fertilizers both at home and abroad is going forward at a record pace and promises to show little, if any, slowing down in the months immediately ahead.

Chemical Engineering Index
Industrial Consumption of Chemicals
1935 = 100

	Jan. Revised	Feb.
Fertilizers	50.07	48.50
Pulp and paper	23.10	22.00
Petroleum refining	19.38	17.60
Glass	24.90	20.70
Paint and varnish	24.34	23.50
Iron and steel	12.90	12.05
Rayon	22.03	19.50
Textiles	12.87	11.36
Coal products	9.90	9.30
Leather	4.65	4.60
Explosives	6.89	6.58
Rubber	6.50	6.30
Plastics	8.10	7.60
	225.63	209.59

Latest reports show a larger volume of plastics moving into consumption and at the March meeting of the Society of the Plastics Industry, held on the Pacific Coast, an improved supply situation for materials was reported and while the expansion program of materials producers is running three to six months behind schedules, it was described as not seriously delaying production of plastics. With the exception of thermosetting molding materials, it was announced that forecasts for the large expansion of the industry, made last year, are being attained and actually exceeded in some instances.

Petroleum products are finding a larger market than had been expected and requirements for the first half of this year are now placed at 7 percent above those for the like 1946 period. Paint manufacturers look for sales to pass a billion dollars this year which is far above anything the industry has yet reached but a part of the rise may be attributed to higher unit prices. Glass container output thus far this year has been of record proportions and with all divisions finding active markets, industry totals are writing a new history. Soap makers are responding to an improved supply condition and a remarkable growth is reported for the newer detergents. Under these conditions, production of chemicals appears to have considerable room for growth before it catches up with full consuming requirements and still further room before disrupting a balance between supply and demand.



Titeflex ALL-METAL FLEXIBLE TUBING—TITEFLEX is the only pressure-tight flexible tubing made from metal strip which does not depend upon a sliding joint for flexibility. Its all-metal construction assures longer life, greater efficiency, and lower maintenance costs in conveying all types of liquids and gases.

Titeflex IGNITION SHIELDING—Widely praised for their performance on military aircraft during World War II, TITEFLEX Ignition Shielding systems are now available for all commercial aircraft, large or small. Complete unit assemblies or component parts for shielding any type engine can be supplied.

Waveflex FLEXIBLE WAVE GUIDES—The extreme flexibility of Waveflex permits confinement in "tight" corners without distortion of critical dimensions of size and shape. The precision construction reduces attenuation and preserves costly transmission energy.

Titeflex, Inc., maintains complete engineering and laboratory facilities for the development of new designs and applications. Ample plant capacity and highly perfected production equipment enables us to manufacture on a quantity and quality basis.

Our engineering and manufacturing facilities are at your complete disposal. Write for further information on your particular problem.

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Exclusive Manufacturers of Titeflex high quality products for more than 30 years

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End Uses For Chemicals

THE BUREAU of the Census has released further data showing end uses of chemicals based on allocation records of the War Production Board. The data with the periods covered are:

Chlorine

Jan. 1, 1944–June 30, 1945

Uses	Tons	Percent
Total allocations	2,092,248	100.0
Export	15,480	0.7
Direct military	57,238	2.7
Other uses	2,019,530	96.6
Chemical manufacture	1,544,787	73.8
Paper processing	254,653	12.2
Metallurgical uses	100,179	4.8
Water treatment	62,730	3.0
Synthetic rubber	14,775	0.7
Food treatment	1,365	0.1
Petroleum refining	1,296	0.1
Miscellaneous	39,745	1.9

Chlorinated Paraffins

Jan. 1, 1944–June 30, 1945

Uses	1,000 lb.	Percent
Total allocations	63,194	100.0
Export	▶ 25	.....
Direct military	▶ 938	1.5
Other uses	62,231	98.5
Flame-proofing	54,669	86.5
Extreme pressure lubricants	6,010	9.5
Cutting and drawing oils	1,416	2.3
Miscellaneous	136	0.2

Sodium Metasilicate

Jan. 1, 1944–Sept. 30, 1944

Uses	1,000 lb.	Percent
Total allocations	89,440	100.0
Export	70	0.1
Direct military	7,984	8.9
General detergents[1]	53,653	60.0
Metal cleaning	18,426	20.6
Food processing	9,337	10.4

[1] Includes laundry and dishwashing compounds.

Anhydrous Ammonia

Jan. 1, 1945–June 30, 1945

Uses	Tons	Percent
Total allocations	264,618	100.0
Export	4,561	1.7
Direct military	43,790	16.6
Other uses	216,267	81.7
Chemical manufacture	68,194	25.8
Agriculture	43,328	16.4
Explosives	31,700	11.9
Aqua ammonia	13,984	5.3
Plastics	15,597	5.9
Refrigeration	7,890	3.0
Miscellaneous	35,574	13.4

Shellac

July 1, 1943–Dec. 31, 1943

Uses	1,000 lb.	Percent
Total allocations	6,496	100.0
Direct military	5	0.1
Other uses	6,491	99.9
Phonographic records	1,394	21.5
Leather, textile, paper treatment	774	11.9
Bonding mica	772	11.9
Hat processing	609	9.4
Electrical parts and insulation	463	7.1
Abrasives	288	4.4
Inks, pencils, printing and engraving	260	4.0
Motors, machines, and parts	227	3.5
Arms, weapons, and ammunition	223	3.4
Containers	184	2.8
Medicine, dentistry, and science	177	2.7
Telephone and radio equipment	168	2.6
Aviation parts and equipment	156	2.4
Vehicles and vessels	144	2.2
Cements and adhesives	136	2.1
Basing cement for tubes and bulbs	109	1.7
Patterns: wood, plaster, and metal	90	1.4
Rubber products	84	1.3
Furniture, mirrors, and refrigerators	71	1.1
Waxes: sealing and emulsion	31	0.5
Identification badges	22	0.3
Floor maintenance and repair	17	0.3
Miscellaneous	92	1.4

CONDENSATION PRECLUDES PURGING WITH STEAM

DRY AND OXYGEN-FREE GAS BLANKETS ARE ESSENTIAL

YOU WANT FULLY AUTOMATIC EQUIPMENT BUILT TO LAST

purge and blanket with KEMP inerts at 8 to 15 cents per Mcf

And these figures include fuel, power, maintenance, and amortization of all initial cost on a five-year basis!

One reason for such economy is that a KEMP inert gas system uses fuel and power only in proportion to output. You don't have to pay full-load costs for partial-load usage. Another is that KEMP inert gas systems are designed for fully automatic operation. You don't have to twist valves and nurse burners to maintain gas composition and accommodate the system to every change in output.

Still another reason is that KEMP builds on the rugged side—for long service in exposed locations — typical of so many of today's "outside plants".

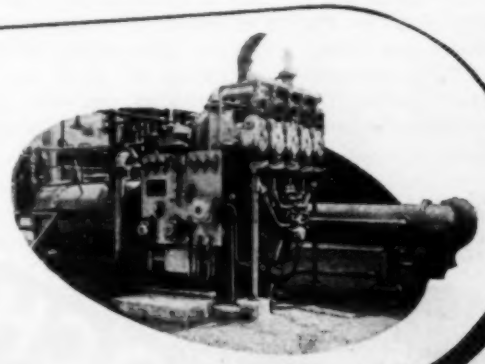
And, finally, KEMP is an old hand at manipulating and controlling combustion reactions. It's been in the business for over 30 years.

HERE'S ONE PRODUCING 30,000 SCF PER HOUR

It's part of a Foster Wheeler installation working for Shell. Its output is chiefly CO_2 and N_2—with only traces of CO, and *no* oxygen—at a dew point of 100°F. It's fired with sulfur-free propane. Its output is used for purging stills, towers and pipelines.

Note the degree of its safety protection. Observe the beef in its design. Note the accessibility of each part.

It's typical of KEMP equipment—practical, efficient, sound. Below is a coupon which will bring full data.



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FOR INDUSTRY'S HEAT-USING PROCESSES
ATMOSPHERE GENERATION & ADSORPTIVE DRYER SYSTEMS
FOR PROCESS CONTROL AND PROTECTION

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THE C. M. KEMP MFG. CO., INC.
405 E. Oliver St., Baltimore 2, Md.

Send me your literature on inert gas generators. Our inert gas requirements are roughly_____scf per hour maximum.

NAME_____

POSITION_____

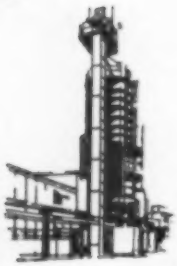
COMPANY_____

PLACE_____

Manufacturing

SYNTHETIC "BEADS"

to make high-test aviation gasoline



AT PAULSBORO, N. J., on the Delaware River, the Socony-Vacuum Oil Company accomplished another war-time miracle when it erected and put into operation, within six months from breaking of ground, a plant for the manufacture of a synthetic catalytic agent needed for the refining of high-test aviation gasoline.

This catalyst consists of tiny beads, the raw materials of which include sodium silicate, sulphuric acid, aluminum trihydrate and river water which has been demineralized and then degasified, under vacuum, in a Cochrane Cold Water Deaerator.

Numbers of Cochrane Cold Water Deaerators were also used in the Manhattan Project. They are worth investigating for problems similar to these.

The water, when taken from the Delaware River, is saturated with oxygen and contains up to 50 ppm of carbon dioxide. After demineralization it passes to the Cochrane Cold Water Deaerator, where, at a minimum temperature of 35°F. and under perfect vacuum conditions, the dissolved oxygen and carbon dioxide are completely removed at 1650 gallons per minute.

COCHRANE CORPORATION
3154 N. 17th St., Philadelphia 32, Pa.

COCHRANE DEGASIFYING EQUIPMENT

Chemical Cotton Pulp

Jan. 1, 1944–June 30, 1945

Uses	Tons	Percent
Total allocations	423,902	100.0
Export	3,160	0.8
Direct military	196,240	46.3
Other uses	224,202	52.9
High tenacity yarn	110,168	26.0
Plastics, film, and lacquer	59,535	14.1
Rayon	35,598	8.4
Meat casings	5,250	1.2
Miscellaneous[1]	13,650	3.2

[1] Includes cotton pulp for explosives produced in private plants.

Animal Glue

July 1, 1944–June 30, 1945

Uses	1,000 lb.	Percent
Total allocations	152,953	100.0
Export	1,868	1.2
Other uses	151,085	98.8
Gummed paper and tape	41,253	27.0
Adhesives	17,030	11.1
Abrasives	12,656	8.3
Paper and paper products	9,606	6.3
Textiles	7,347	4.8
Gaskets and cork products	5,828	3.8
Containers	5,216	3.4
Matches	4,296	2.8
Woodworking	3,601	2.4
Bookbinding	1,349	0.8
Printer rollers	1,343	0.8
Miscellaneous	41,740	27.3

Copper Sulphate

Jan. 1, 1944–June 30, 1945

Uses	1,000 lb.	Percent
Total allocations	359,037	100.0
Direct military	55	.....
Export	121,383	33.8
Other uses	237,600	66.2
Agriculture	160,447	44.7
Mining-ore flotation	18,337	5.1
Mildew-proofing	8,693	2.4
Catalyst	6,156	1.7
Dyes and pigments	5,803	1.6
Water purification	5,350	1.5
Wire drawing	4,294	1.2
Pharmaceuticals	1,487	0.4
Gasoline sweetener	1,166	0.3
Electroplating	969	0.3
Wood preservatives	402	0.2
Miscellaneous	24,448	6.8

Naphthenic Acid

July 1, 1944–June 30, 1945

Uses	1,000 lb.	Percent
Total allocations	31,761	100.0
Export	2	.....
Direct military	7,220	22.7
Other uses	24,539	77.3
Fungicides and wood preservatives	15,619	49.2
Driers	4,911	15.5
High pressure lubricants	1,319	4.2
Rust preventatives	961	3.0
Ore flotation, solvation, and emulsification	804	2.5
Cutting oils	405	1.3
Metal cleaning and degreasing	161	0.5
Miscellaneous	359	1.1

Chromic Acid

Jan. 1, 1944–Dec. 31, 1944

Uses	1,000 lb.	Percent
Total allocations	17,395	100.0
Export	174	1.0
Metal treatment	12,971	74.6
Chemical manufacture[1]	765	4.4
Corrosion prevention[2]	299	1.7
Miscellaneous	3,186	18.3

[1] Excludes chromic acid used in the manufacture of other primary chromium chemicals. [2] Includes metal alloys.

Normal Butyl Acetate

July 1, 1944–June 30, 1945

Uses	1,000 lb.	Percent
Total allocations	75,347	100.0
Export	9,309	12.4
Direct military	7	.....
Other uses	66,031	87.6
Protective coatings	63,467	84.2
De-icers	925	1.2
Cements and adhesives	617	0.8
Resins and plastics	201	0.3
Medicinals	133	0.2
Miscellaneous	688	0.9

Penn-Drake PETROSULS

Petroleum Sulfonates

For

EMULSIFICATION • DISPERSION • RUST PREVENTION
MUTUAL SOLVENT ACTION • DETERGENCY
PREPARATION OF METALLIC SOAPS

The importance of petroleum sulfonates as a class of industrial surface active agents makes them a reliable foundation upon which can be developed formulations possessing innumerable and hitherto unobtainable properties.

Penn-Drake Petrosuls are oil-soluble petroleum sulfonates or "mahogany soaps" of reddish-brown color. Two types are offered:

PETROSUL 745 is a low molecular weight "mahogany soap" which possesses oil solubility, surface active properties, stability, and water-solubilizing properties.

PETROSUL C SERIES consists of selected high molecular weight petroleum sulfonates in either aqueous or petroleum oil concentrations. The Petrosul C Series possess greater colloidal stability in aqueous solutions.

As primary surface active agents, Petrosuls function as corrosion inhibitors. Complete miscibility in petroleum oils, combined with stable, colloidal, dispersibility in water, makes Petrosuls the ideal primary emulsifier for soluble oils. A secondary function is that as mutual solvent or coupling agent.

Full details and samples will be sent upon request.

Properties of Penn-Drake Petrosuls

	Petrosul C-900	Petrosul C-750	Petrosul C-500	Petrosul W-50	Petrosul 745
COMPOSITION					
Sodium Sulfonate, Min.	75%	62%	47.5%	40%	62%
Mineral Oil, Max.	15%	35%	50%	10%	35%
Water, Max.	10%	3%	2.5%	50%	3%
Alkalinity (Na_2O)	0.03%	0.03%	0.03%	0.03%	0.05%
PROPERTIES					
Color	Reddish-Brown	Reddish-Brown	Reddish-Brown	Reddish-Brown	Reddish-Brown
Specific Gravity	1.04 to 1.07	1.02 to 1.04	0.99 to 1.01	1.02 to 1.04	1.02 to 1.04
Pounds per Gal.	8.80	8.50	8.40	8.50	8.50
Molecular Weight (Dry, Oil-free Sulfonates)	510(Approx.)	510(Approx.)	510(Approx.)	510(Approx.)	450(Approx.)
SURFACE TENSION (on blended Sulfonates)					
@ 25°C					
0.1% in distilled water	39.2 Dynes	44.6 Dynes	44.6 Dynes	40.8 Dynes	48.3 Dynes
1.0% in distilled water	34.7 Dynes	35.9 Dynes	38.0 Dynes	38.8 Dynes	38.8 Dynes
@ 70°C					
0.1% in distilled water	33.9 Dynes	38.0 Dynes	38.0 Dynes	35.5 Dynes	42.1 Dynes
1.0% in distilled water	31.9 Dynes	31.9 Dynes	31.9 Dynes	31.9 Dynes	33.4 Dynes

penn drake petroleum products

PENNSYLVANIA REFINING COMPANY

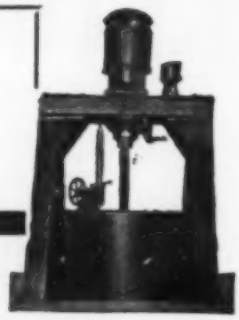
General Offices: BUTLER, PA.

Refineries at KARNS CITY and TITUSVILLE, PA.
Branches: CLEVELAND, OHIO; EDGEWATER, N. J.

MAKERS: White Oils (U.S.P. and Technical); Petrolatums (all grades and colors); INSECTI-SOL (deodorized insecticide base); Deodorized and other Naphthas; Petroleum Sulfonates; Warner Industrial and Motor Lubricants and Greases; Fuel Oils, and other petroleum products.

SELF-BALANCING . . .

TO HANDLE UNBALANCED LOADS WITHOUT DIFFICULTY



with LARGEST CAPACITY in proportion to basket diameter . . . HIGHEST SPEED in acceleration, braking, running and unloading . . . LABOR-SAVING large bottom discharge for solids. And, these rugged, dependable, precision-built machines give complete satisfaction in time- and money-saving operation. Write for catalog . . . engineering consultation available without obligation.

FLETCHER CENTRIFUGALS

MOTOR-DRIVEN SUSPENDED AND OPEN-TOP

FLETCHER WORKS, 235 GLENWOOD AVE., PHILADELPHIA 40, PA.

Copper Oxides

Jan. 1, 1944–June 30, 1945

Uses	1,000 lb.	Percent
Total allocations	27,640	100.0
Direct military	5,498	19.9
Export	106	0.4
Other uses	22,036	79.7
Anti-fouling paints	18,687	67.6
Dyes and pigments	544	2.0
Electroplating	732	2.6
Agriculture	504	1.8
Gasoline sweetener	360	1.3
Catalysts	326	1.2
Miscellaneous	883	3.2

Pine Tar and Pine Tar Oil

July 1, 1944–June 30, 1945

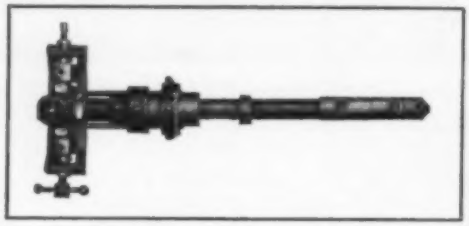
Uses	1,000 gal.	Percent
Total allocations	4,825	100.0
Export	328	6.8
Other uses	4,497	93.2
Rubber compounding	2,270	47.0
Rubber reclaiming	933	19.3
Cordage	657	13.6
Ship construction and maintenance	285	5.9
Medicinals and pharmaceuticals	86	1.8
Lubricants	62	1.3
Adhesives	48	1.0
Preservatives	35	0.7
Coating	27	0.5
Cutting oils	7	0.2
Belt dressing	5	0.1
Waterproofing compound	4	0.1
Flotation	3	0.1
Insecticides	3	0.1
Miscellaneous	72	1.5

Pentaerythritol

Jan. 1, 1944–June 30, 1945

Uses	1,000 lb.	Percent
Total allocations	21,602	100.0
Export	221	1.0
Resins and plastics	10,717	49.6
Explosives	9,275	42.9
Drying oils	1,072	5.0
Miscellaneous	317	1.5

NATIONAL AIROIL FUEL OIL BURNERS



TYPE "SAL" OIL BURNER

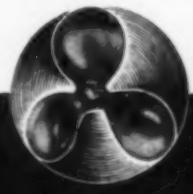
assures HIGH FUEL CAPACITY . . . thus reducing the number of burners needed

Type "SAL" Steam Atomizing Oil Burner is a large capacity burner with great flexibility of performance throughout a wide operating range. Because of thorough atomization it produces a clean, steady, well-defined flame, which completely burns the fuel oil. It reduces the tendency to smoke, form soot or incur carbon losses.

Bulletin 24 fully describes Type "SAL" Burners and their application. Write for your copy, today.

NATIONAL AIROIL BURNER CO., INC.

Main Offices & Factory: 1235 EAST SEDGLEY AVENUE, PHILADELPHIA 34, PA.
Texas Office: 2nd National Bank Bldg., Houston



Smooth Vibrationless MICHIGAN MACHINED-PITCH PROPELLERS for MIXING or AGITATION

For replacement or original equipment. Perfectly balanced to avoid whip and strain on equipment. Wide range of sizes and metals in 2 and 3 blade models. Free consultative engineering service. Write for details.

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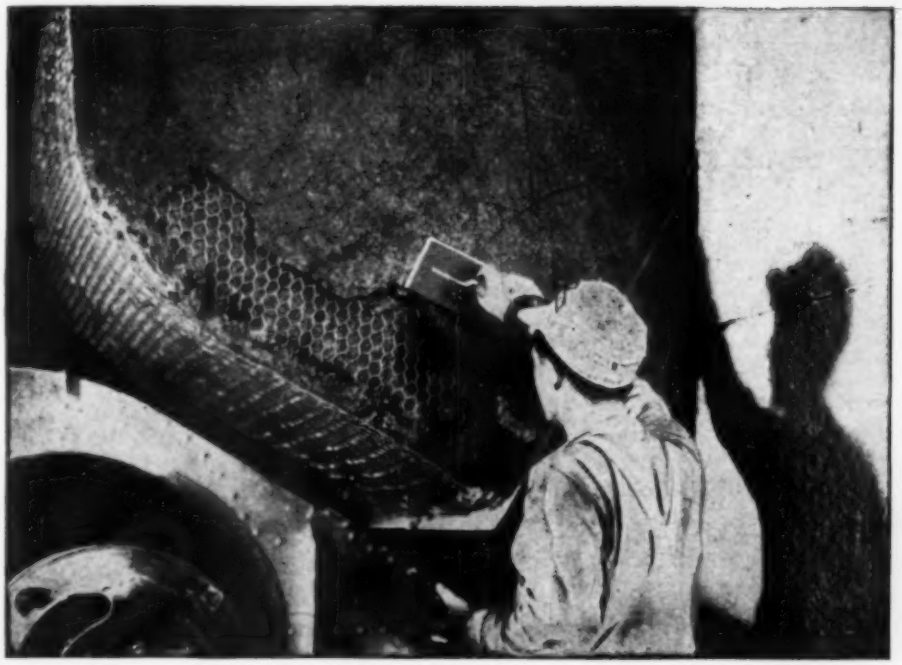
GRAND RAPIDS 3, MICHIGAN



Users applaud the high Rust-Inhibition of Eagle Super "66" Insulating Cement

Men who have used Eagle Super "66" Insulating Cement are enthusiastic not only about its great fuel-saving ability — they applaud the way Super "66" actually inhibits rust on heated metal equipment!

This unique rust-inhibitive quality has been conclusively proved by laboratory tests, and in actual use. It's an important factor in prolonging the life of boilers, ovens, tanks, towers, heat exchangers, etc.

"Springy Ball" structure gives remarkable efficiency

The tremendous insulating efficiency of Super "66" comes from its "Springy Ball" pellets of Eagle Mineral Wool. Each pellet is a maze of dead air cells — one of Nature's most effective barriers against passage of heat. "Springy Ball" structure is permanent — lasts as long as the insulation.

Eagle Super "66" withstands a full range of temperatures up to 1800° F. If not subjected to temperatures above 1200° F., it can be *removed, remixed* and *re-used!* An all-purpose insulation, it can be troweled with little effort on almost any size or shape surface. Wet coverage is as high as 65 sq. ft. per 100 lbs., 1 in. thick . . . and shrinkage is less than 15%.

Send for data sheets. *They contain complete technical information about Eagle Super "66". Available on request.*

Other Eagle Industrial Products include:

Eagle Insulseal. A protective coating for insulation. Trowels on — dries to a hard finish. Withstands temperatures up to 450° F.

Eagle Swetchek (black). A prepared, asphaltic base, rust-inhibitive anti-condensation compound.

Eagle "43" Finishing Cement. A hard white finish coating for all types of indoor insulation within a range from 70° F. to 800° F.

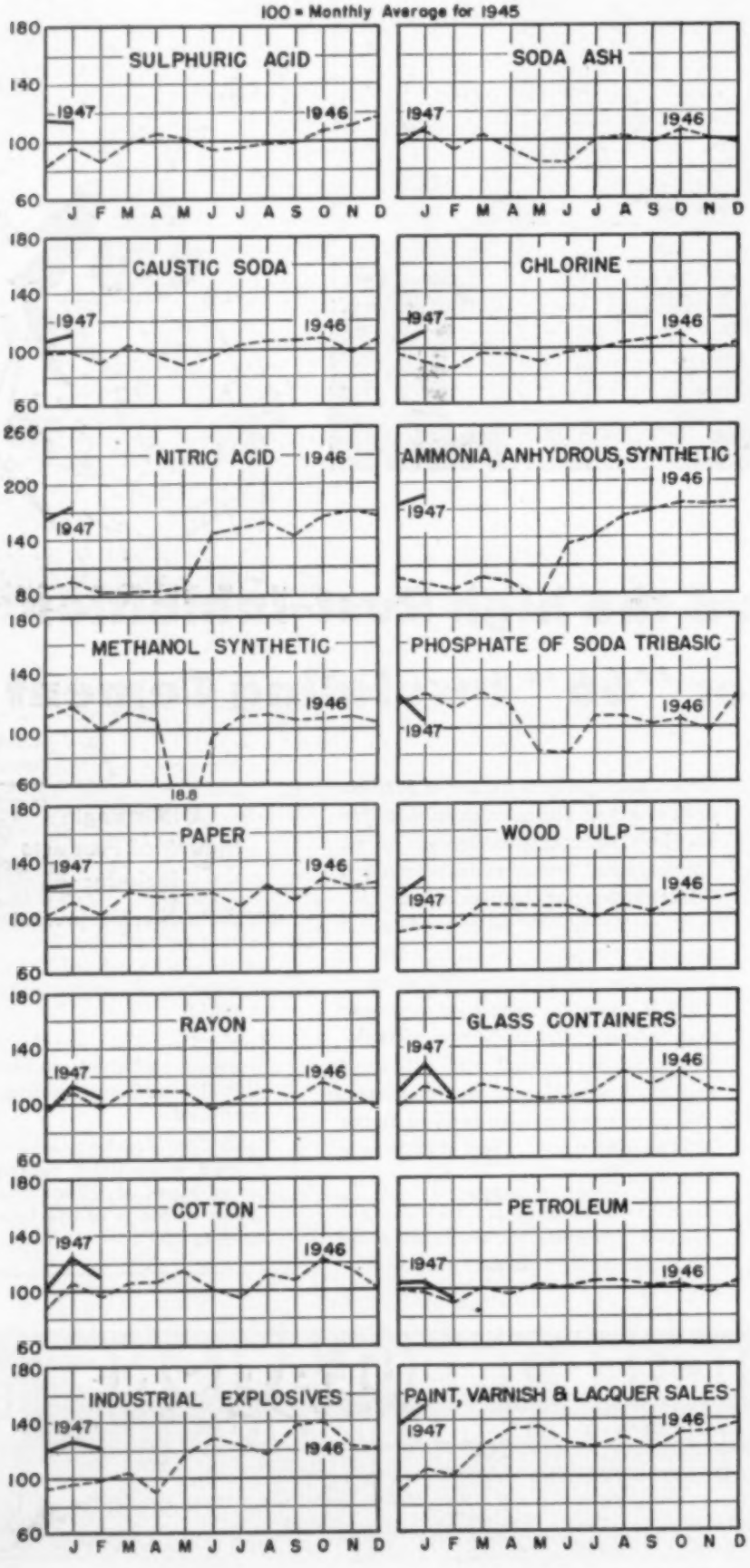
EAGLE-PICHER INSULATIONS
High and Low Temperature

EAGLE EP PICHER

THE EAGLE-PICHER COMPANY • CINCINNATI (1), OHIO

Eagle Super "66" Insulating Cement • Eagle L-T and M-2 Felt • Eagle Supertemp Block • Eagle Blankets • Eagle Pipe Covering
Eagle Insulseal • Eagle Loose Wool • Eagle Insulstic • Eagle Swetchek

PRODUCTION AND CONSUMPTION TRENDS

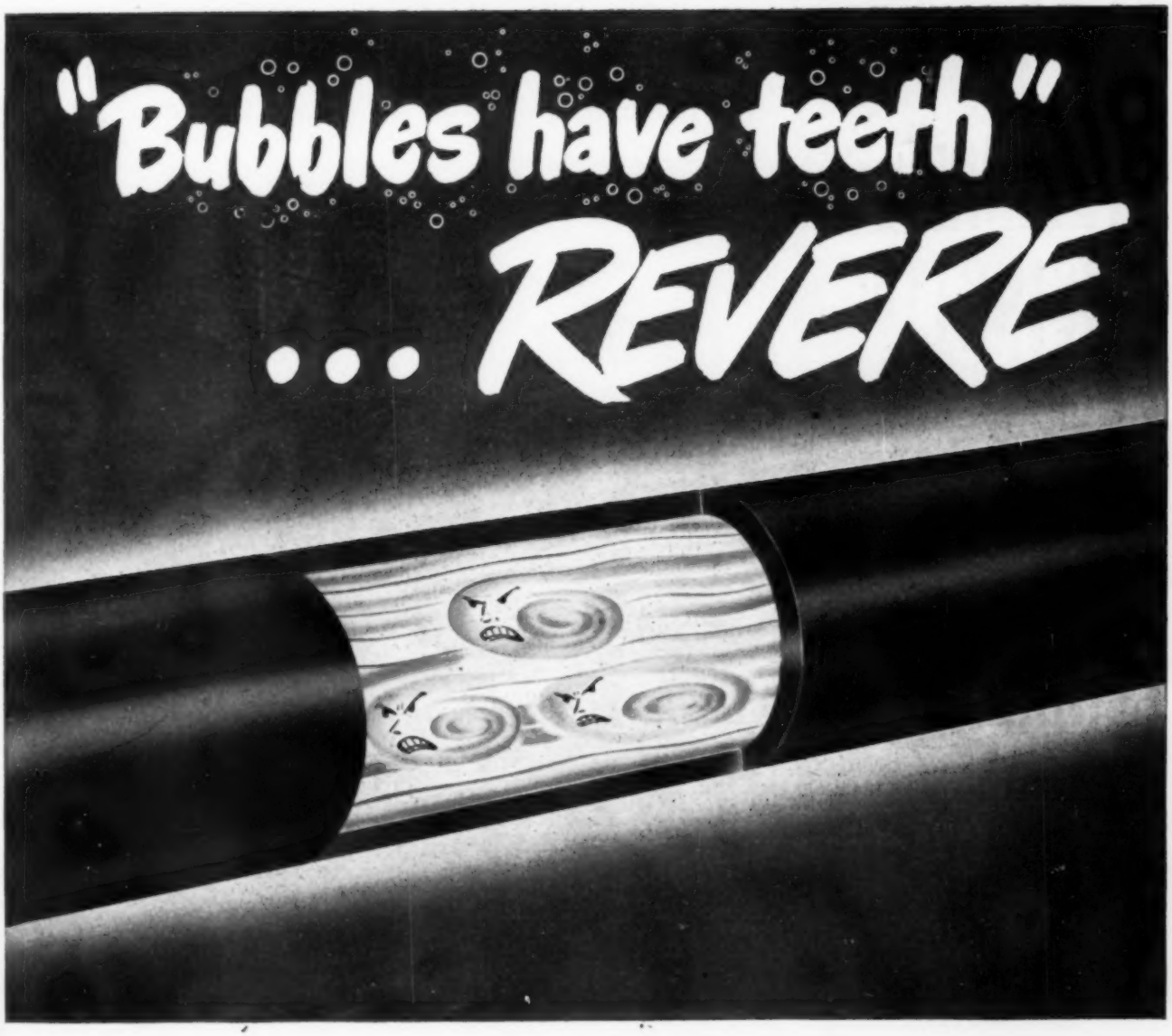


PRODUCERS of fermentation products who rely upon blackstrap molasses as a raw material have had their position somewhat clarified through an announcement by the International Emergency Food Council of allocations for 1947; clarified by the establishment of definite figures for the expected supply but greatly disturbed by the fact that the alloted amount will fall far short of meeting requirements. To begin with, the Council had estimated domestic blackstrap requirements at 364 million gallons which consuming industries considered to be too low, and the actual allocation was 246.1 million gallons. This is to come from domestic production plus the total output of Puerto Rico, Hawaii, and the Dominican Republic – estimated at 173 million gallons – and 73.1 million gallons from Cuba.

Recent sales of blackstrap have been made on a competitive bidding basis and prices have been steadily soaring. As a result sales schedules for ethyl alcohol and other fermentation products have moved up sharply and contributed to the rising price curve for chemicals. Excess of consuming demand over supply combined with rising productions costs continue to give a strong price tone to the majority of chemicals and while a few weak spots developed in the last few weeks, the general trend remains unchanged. The runaway price market for oils and fats and the marked increase in values for a limited number of chemicals have given rise to some fears that the pattern of the early twenties is being followed when a collapse from an unusually high price level had a depressing effect of wide industry proportions. However, the commodities which are now selling at very high peaks are following production costs more closely and danger of large financial losses is minimized by the comparative absence of long-term commitments.

From a production standpoint, most branches of chemical manufacture are operating as close to capacities as they can in view of material shortages and the scarcity of cars for distribution. Very much the same situation is reported for the principal chemical-consuming industries and it would take more than a mild recession in business to bring consuming requirements for chemicals down to the current capacity to produce them.

The 13 regional Shippers Advisory Boards estimate second quarter freight car loadings at 33.2 percent over those of the comparable months of last year.



SOME years ago Revere said that "Bubbles have teeth." It is still true. Air bubbles in a condenser can eat away at the tubes quite rapidly, and become a cause of failure with consequent re-tubing. Air-entrainment, as it is called, acts in several ways, all destructive to tubes. Air contains oxygen, which directly attacks most metals, forming oxides. Carbon dioxide in solution dissolves these oxides. That is not all. Air bubbles add to the erosion effect of turbulent flow. The higher the velocity, the worse the effect, and the more swift and serious is the combination of erosion and corrosion at points of greatest disturbance. Every effort should be made therefore to keep air from being carried into the cooling water. If you are troubled by frequent re-tubing of your condenser, get in touch with Revere, but first save a few samples from failed tubes for examination by our laboratories to determine the cause of failure. Many users of condenser tubes have found our collaboration exceedingly valuable, and we are always glad to cooperate in an effort to extend tube life.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities, Distributors Everywhere.

Multi-Metal

Wire Cloth
Filter Cloth
All Meshes
All Metals

FABRICATED WIRE CLOTH

For more than 34 years Multi-Metal has designed and fabricated an infinite variety of filter units which involve the use of wire cloth. Multi-Metal stresses its technical facility. In addition to our fabrication plant, we carry a wide variety of wire cloth which is available by the roll and cut piece. Write for our new catalog and free wire cloth samples.

Multi-Metal
WIRE CLOTH COMPANY, INC.
1350 Garrison Ave., New York 59, N. Y.

United States Production of Certain Chemicals

January 1947 and January 1946

Chemical	Unit	January 1947	January 1946
Ammonia, synthetic, anhydrous[1]	Tons	85,121	41,384
Ammonium nitrate (100% NH_4NO_3)	Tons	89,747	37,695
Ammonium sulphate, synthetic, technical	M lb.	24,487	24,496
Calcium arsenate ($Ca_3(AsO_4)_2$)	M lb.	1,765	952
Calcium carbide, commercial	Tons	50,675	45,192
Calcium phosphate:			
Monobasic (100% $CaH_4(PO_4)_2$)	M lb.	6,731	5,569
Dibasic (100% $CaHPO_4$)	M lb.	9,817	7,750
Carbon dioxide:			
Liquid and gas	M lb.	17,603	17,767
Solid	M lb.	42,851	38,323
Chlorine	Tons	110,088	89,707
Chrome green (C. P.)	M lb.	1,613	1,748
Chrome yellow and orange (C. P.)	M lb.	3,608	4,617
Hydrochloric acid (100% HCl)	Tons	35,144	26,822
Hydrogen	M cu. ft.	1,651	1,426
Lead arsenate, acid and basic	M lb.	4,923	6,421
Molybdate chrome orange (C. P.)	M lb.	429	464
Nitric acid (100% HNO_3)	Tons	64,138	34,769
Oxygen	M cu. ft.	1,101	715
Phosphoric acid (50% H_3PO_4)	M lb.	78,595	73,352
Soda ash:			
Ammonia-soda process:			
Total wet and dry[2]	Tons	380,589	387,012
Finished light[3]	Tons	194,825	196,492
Finished dense	Tons	129,815	132,339
Natural[4]	Tons	18,704	17,158
Sodium bicarbonate, refined	Tons	15,485	15,132
Sodium bichromate and chromate	Tons	6,979	7,735
Sodium hydroxide:			
Electrolytic process:			
Liquid[5]	Tons	108,688	86,072
Solid	Tons	17,980	17,757
Lime soda process:			
Liquid[5]	Tons	64,671	68,427
Solid	Tons	21,416	21,618
Sodium phosphate:			
Monobasic (100% NaH_2PO_4)	Tons	1,094	1,244
Dibasic (100% Na_2HPO_4)	Tons	6,238	5,727
Tribasic (100% Na_3PO_4)	Tons	7,811	9,216
Meta (100% $NaPO_3$)	Tons	2,144	2,272
Tetra (100% $Na_4P_2O_7$)	Tons	4,110	4,343
Sodium silicate, anhydrous	Tons	39,991	34,524
Sodium sulphate:			
Anhydrous, refined	Tons	12,178	10,491
Glauber's salt (100% $Na_2SO_4 10H_2O$)[6]	Tons	17,338	13,826
Salt cake, crude, commercial[6]	Tons	48,937	37,495
Sulphuric acid:[7]			
Chamber process	Tons	294,312	256,137
Contact process, new[8]	Tons	546,826	432,678
Zinc yellow (zinc chromate) (C. P.)	Tons	234	.....

Data for this tabulation have been taken from "Facts for Industry" series issued by Bureau of the Census and WPB Chemicals Bureau. Production figures represent primary production and do not include purchased or transferred materials. Quantities produced by government-owned arsenals, ordnance works, and certain plants operated for the government by private industry are not included. Chemicals manufactured by TVA, however, are included. All tons are 2,000 lb. Where no figures are given, data are either confidential or not available. [1] Includes a small amount of aqua ammonia. [2] Total wet and dry production, including quantities diverted for manufacture of caustic soda and sodium bicarbonate, and quantities processed to finished light and finished dense. [3] Not including quantities converted to finished dense. [4] Data collected in cooperation with the Bureau of Mines. [5] Figures represent total production of liquid material, including quantities evaporated to solid caustic and reported as such. [6] Includes oleum grades, excludes spent acid. [7] Data for sulphuric acid manufactured as a byproduct of smelting operations are included. [8] Revised.

United States Production of Certain Synthetic Organic Chemicals

December 1946, December 1945 and Twelve-Month Totals for 1946 and 1945

Chemical	December 1946	December 1945	Total, Twelve Months 1946	1945
Acetanilid	984,834	.....	.....	6,951,294
Acetic acid:				
Synthetic[1]	29,298,123	22,476,478	284,826,346	263,294,756
Recovered	111,609,087	63,616,951	1,191,233,817	1,006,643,721
Natural[2]	2,426,773	1,845,913	28,064,371	31,645,086
Acetic anhydride[3]	48,703,382	44,294,138	521,979,639	526,264,258
Acetone	33,966,787	25,591 935	335,928,986	351,422 643
Acetylsalicylic acid	964,692	910,287	9,852,167	10,860,346

(Continued on page 322)

BRYANT SILICA-GEL
AIR-DRYERS

Model 8R

Provide a continuous flow of dry air for
LOW TEMPERATURE DRYING AND ACCURATE CONTROL OF HUMIDITY

Available through air conditioning engineers and contractors

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BRYANT HEATER COMPANY
AIR DRYER DIVISION
17825 ST. CLAIR AVE., CLEVELAND 10, O.
ONE OF THE DRESSER INDUSTRIES

MATERIALS of CONSTRUCTION
for Chemical Engineering Equipment

★ Copies of *Chemical Engineering's* Twelfth Report on Materials of Construction are now available. This 96-page booklet gives data on 58 materials used in the process industries. It also includes an article on corrosion problems of the Oak Ridge atomic plant and 8 pages of data and information on gaskets and packings..... $1

Editorial Department

CHEMICAL ENGINEERING • 330 West 42nd St., New York 18, N. Y.

A Valve You Can Trust in Exposed Locations

CHAPMAN LIST 960

This small forged steel gate valve has a flanged forged steel packing gland which eliminates exposed threading on the yoke and affords protection against rust and corrosion when the valve is used in an exposed location. Bonnet is fitted with a substantial forged steel yoke. No gaskets to blow as in valves with flanged bonnet connections.

Chapman List 960 is made in sizes from ¼" to 2"—carbon steel for pressures to 800 pounds at 750° F. For higher pressures, specify List 990.

THE CHAPMAN VALVE MFG. CO.
INDIAN ORCHARD, MASS.

• FILTER CLOTH

• FILTER PRESS SACKS ALL KINDS

WOVEN GLASS AND "DURAKLAD" (ACID RESISTANT)

• FILTER FABRICS

Made into all sizes and constructions, filter cloths, tubes, discs, gravity bags, centrifuge liners, rotary filters, flotation blankets, etc.

GLASS CLOTH FOR HIGH TEMPERATURES

is acid and alkali resistant, has a smooth, hard surface, free from lint, made into a wide variety of weaves and widths. Can be fabricated to meet your requirements.

VACUUM BAG & DUST ARRESTING TUBES

for all purposes

Send Sketch or Specifications of Material Required

WM. W. STANLEY CO., Inc.

401 Broadway, New York 13, N. Y.

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INDICATOR

Pyrometer

Built with the ENGELHARD frictionless galvanometer, eliminating bearings and pivots.

Strongly built to stand rough service. Nine standard scales—4 Centigrade, 5 Fahrenheit. Special scales available. Weight 11½ lbs.

Write for descriptive Bulletin 400

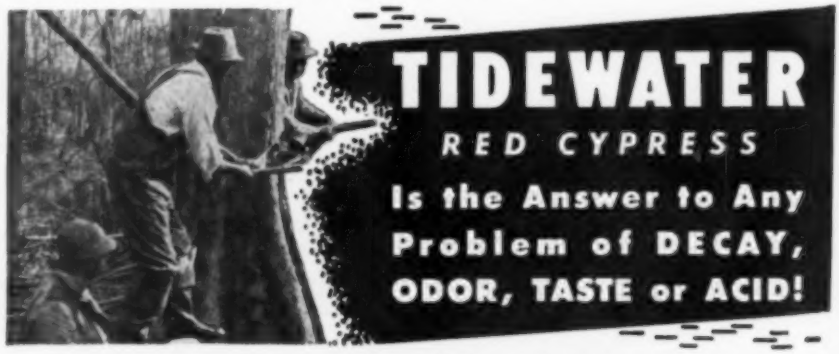
Charles Engelhard, Inc.

900 Passaic Ave. East, NEWARK, N. J.

U. S. Production of Synthetic Organic Chemicals (Cont. from page 320)

Chemical	December 1946	December 1945	Total, Twelve Months 1946	Total, Twelve Months 1945
Aniline	7,807,312	5,945,580	89,124,604	88,493,006
Barbituric acid derivatives::				
5-Ethyl-5-phenylbarbituric acid and salts (Phenobarbital)	45,368	15,863	396,059	276,763
Benzene:				
Motor grade:				
Tar distillers[4]	630,575	487,426	9,034,560	3,978,333
Coke oven operators[6]	1,485,629	4,812,492	29,717,752	28,173,199
All other grades:				
Tar distillers[4]	1,328,664	1,314,228	19,957,013	31,956,745
Coke-oven operators[6]	9,782,518	8,780,556	107,829,560	127,056,339
Butyl alcohol, primary, normal	13,857,214	10,013,322	125,812,155	129,275,394
Carbon bisulphide	28,867,536	26,630,669	302,543,024	329,844,695
Carbon tetrachloride	11,606,269	13,080,177	145,765,551	190,053,616
Chlorobenzene, mono	34,449,087	19,094,194	268,638,134	234,763,921
Creosote oil:				
Tar distillers	10,631,726	9,694,584	112,235,692	127,277,483
Coke-oven operators	2,849,484	2,364,237	29,543,068	35,342,391
Cresols:[7]				
Meta-para	331,349	544,319	5,548,818	7,833,171
Ortho-meta-para	925,566			9,708,509
Cresylic acid, refined[7,10]	1,816,930	2,108,164	33,466,483	29,224,083
Dibutyl phthalate	1,549,616	1,180,722		41,838,451
Dichlorodiphenyltrichloroethane (DDT)	3,904,814	5,183,288	44,577,955	32,998,587
Ethyl acetate (85%)	9,603,012	7,109,575	95,765,185	103,654,106
Ethyl ether, technical and U.S.P.	3,436,686	3,020,034	39,922,279	75,580,610
Formaldehyde (37 % by wt.)	39,434,828	29,252,064	460,048,599	477,822,274
Methanol:				
Natural[9]	1,176,402	1,568,355	15,688,109	18,686,726
Synthetic	43,190,241	45,304,861	491,635,932	491,459,899
Naphthalene:				
Tar distillers:				
Less than 79°C.	17,393,649	14,893,551	184,965,066	205,923,008
79°C. and over	7,324,059	7,015,766	95,565,766	77,229,365
Coke-oven operators (less than 79°C.)	5,760,449	7,036,372	70,909,612	87,573,464
Penicillin	2,654,893	841,129	28,108,691	
Phenol, synthetic and natural	19,597,615	14,738,105	199,136,233	204,815,380
Phthalic anhydride	10,343,663	8,555,102	108,703,077	123,301,944
Styrene, government owned plants only	34,967,400	24,412,751	374,866,670	375,118,886
Toluene:				
Coke-oven operators[6]	1,775,968	1,668,847	16,946,493	27,588,053
All other[8]	3,619,750	919,051	16,987,905	122,453,532

All data in pounds except benzene (gal.) creosote oil (gal.), toluene (gal.), and penicillin (million Oxford units). Statistics collected and compiled by U. S. Tariff Commission except where noted. Absence of data on production indicates either that returns were unavailable or confidential. [1] Excludes the statistics on recovered acid. [2] Acid produced by direct process from wood and from calcium acetate. [3] All acetic anhyride including that from acetic acid by vapor-phase process. [4] Product of distillers who use purchased coal tar only or from oil gas or water-gas produced or purchased by tar distillers. [5] Statistics are given in terms of bulk medicinals only. [6] Statistics collected by Bureau of Mines. [7] Total production including data reported both by coke-oven operators and by distillers of purchased coal tar. [8] Reported to U. S. Bureau of the Census. [9] Includes toluene produced from petroleum by any process. [10] Includes refined cresylic acid from petroleum.



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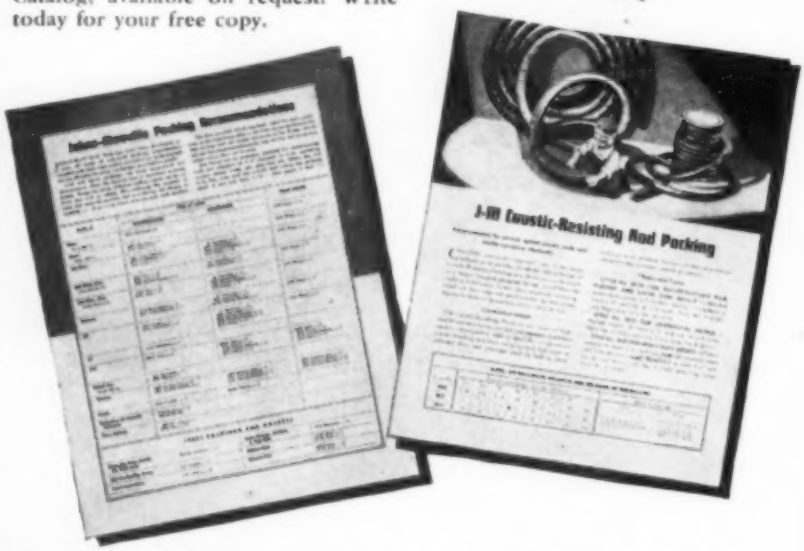

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Johns-Manville
PACKINGS & GASKETS

CHEMICAL ENGINEERING
Weighted Index of Prices for CHEMICALS

Base = 100 for 1937

This month	**125.94**
Last month	123.79
April, 1946	109.13
April, 1945	108.93

CURRENT PRICES

The accompanying prices refer to round lots. Where it is trade custom to sell f.o.b. works, quotations are so designated. Prices are corrected to April 11.

INDUSTRIAL CHEMICALS

Acetone, tank, lb	$0.07 - $0.09
Acid, acetic, 28%, bbl., 100 lb	3.78 - 4.03
Boric, bbl., ton	119.00 - 123.00
Citric, drums, lb	.24½ - .26
Formic, cbys., lb	.12 - .12½
Hydrofluoric, 30%, drums, lb	.08 - .085
Lactic, 44% tech., light, bbl., lb	.073 - .075
Muriatic, 18°, tanks, 100 lb	1.05 -
Nitric, 36°, carboys, lb	.05 - .05
Oleum, tanks, wks., ton	19.50 - 20.00
Oxalic, crystals, bbl., lb	.13 - .14
Phosphoric tech., tanks, lb	.0465 -
Sulphuric, 60°, tanks, ton	13.00 -
Tartaric, powd., bbl., lb	.49½ - .50
Alcohol, amyl from pentane, tanks, lb	.15½ -
Alcohol, butyl, tanks, lb	.14½ - .31
Alcohol, ethyl, denatured, No. 1 special, tanks, gal	98½ -
Alum, ammonia, lump, lb	.04½ -
Aluminum sulphate, com. bags, 100 lb	1.15 - 1.25
Ammonia, anhydrous, cyl., lb	.16 - .20
tanks, ton	59.00 - 61.50
Ammonium carbonate, powd., casks, lb	.09½ - .10
Sulphate, wks., ton	30.00 - 32.00
Amyl acetate, tech. from pentane, tanks, lb	.21 -
Aqua ammonia, 26°, drums, lb	.03 - .03½
tanks, ton	65.00 -
Arsenic, white powd., bbl., lb	.06 - .07
Barium carbonate, bbl., ton	67.50 - 75.00
Chloride, bags, ton	80.00 - 90.00
Nitrate, casks, lb	.09½ - .11
Blanc fixe, dry, bags, ton	67.50 - 72.50
Bleaching powder, f.o.b. wks., drums, 100 lb	2.75 - 3.00
Borax, gran., bags, ton	48.50 -
Calcium acetate, bags, 100 lb	3.00 -
Arsenate, dr., lb	.09 - .10
Carbide, drums, ton	50.00 -
Chloride, flake, bags, del., ton	21.50 - 38.00
Carbon bisulphide, drums, lb	.05 - .05½
Tetrachloride, drums, lb	.06½ - .07
Chlorine, liquid, tanks, wks., 100 lb	2.00 - 2.30
Copperas, bgs., f.o.b., wks., ton	17.00 - 18.00
Copper carbonate, bbl., lb	.26 - .27
Sulphate, bags, 100 lb	7.60 - 7.75
Cream of tartar, bbl., lb	.41½ - .42
Diethylene glycol, dr., lb	.14 - .15
Epsom salt, dom., tech., bbl., 100 lb	2.05 - 2.25
Ethyl acetate, tanks, lb	.09½ - .19½
Formaldehyde, 30%, tanks, wks., lb	.037 -
Furfural, tanks, lb	.09½ -
Glauber's salt, bags, 100 lb	1.25 - 1.50
Glycerine, c. p., drums, extra, lb	.55 - .60
Lead:	
White, basic carbonate, dry, casks, lb	.15½ -
Red, dry, sck., lb	.18 -
Lead acetate, white crys., bbl., lb	.19½ - .20½
Arsenate, powd., bags, lb	.21½ - .22
Lithopone, bags, lb	.05½ - .06
Magnesium carb., tech., bags, lb	.07½ - .08
Methanol, 95%, tanks, gal	.60 -
Synthetic, tanks, gal	.24 - .29
Phosphorus, yellow, cases, lb	.22 - .25
Potassium bichromate, bags, lb	.10½ - .10½
Chlorate, powd., lb	.11 - .11½
Hydroxide (c'stic potash) dr., lb	.07½ - .09½
Muriate, 60%, bags, unit	.53½ -
Nitrate, ref., bbl., lb	.08½ - .31
Permanganate, drums, lb	.20½ - .21½
Prussiate, yellow, casks, lb	.19 - .20
Sal ammoniac, white, casks, 100 lb	4.75 - 5.00
Salsoda, bbl., 100 lb	1.10 - 1.20
Salt cake, bulk, ton	20.00 -
Soda ash, light, 58%, contract, bags, 100 lb	1.20 -
Dense, bags, 100 lb	1.28 -
Soda, caustic, 76% solid, drums, 100 lb	2.50 -
Acetate, del., lb	.05½ - .06
Bicarbonate, bags, 100 lb	2.25 -
Bichromate, bags, lb	.08½ - .08½
Bisulphate, bulk, ton	20.00 - 24.00
Bisulphite, bbl., lb	.03 - .04

CHEMICAL ENGINEERING

Weighted Index of Prices for OILS & FATS

Base = 100 for 1937

This month	345.62
Last month	340.10
April, 1946	145.80
April, 1945	145.85

Chlorate, kegs, lb	$0.06½	$0.06¾
Cyanide, cases, dom., lb	.14½	.15
Fluoride, bbl., lb	.09½	.09¾
Hyposulphite, bags, 100 lb	2.25	2.50
Metasilicate, bbl., 100 lb	3.40	4.00
Nitrate, bulk, ton	32.00	38.50
Nitrite, casks, lb	.06½	.07
Phosphate, tribasic, bags, 100 lb	3.50	
Prussiate, yel., bags, lb	.12	.12½
Silicate, 40°, dr., wks., 100 lb	.95	1.00
Sulphite, crys, bbl., lb	.02½	.02¾
Sulphur, crude at mine, long ton	16.00	
Dioxide, cyl., lb	.085	.09
Dioxide, tanks, lb	.044	
Tin crystals, bbl., lb	.55	
Zinc chloride, gran., bbl., lb	.07	.07½
Oxide, lead free, bags, lb	.09½	.09¾
Oxide, 35% leaded, bags, lb	.11½	.11¾
Sulphate, bags, cwt	4.15	7.00
OILS AND FATS		
Castor oil, No. 3 dr., lb	$0.33	
Chinawood, oil, tanks, lb	.38	
Coconut oil, Ceylon, N. Y., lb	.22	
Corn oil, crude, tanks, (f.o.b. mill), lb	.34	
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.35	
Linseed oil, raw, car lots, dr., lb	.385	
Palm, casks, lb	nom.	
Peanut oil, crude, tanks (mill), lb	.33	
Rapeseed oil, refined, bbl., lb	.32	
Soybean, tanks, lb	.30	
Menhaden, light, pressed, dr., lb	.29	
Crude, tanks (f.o.b. factory), lb	.23	
Grease, yellow, loose, lb	.24	
Oleo stearine, lb	nom.	
Oleo oil, No. 1, lb	.32	
Red oil, distilled, bbl., lb	.30	
Tallow, extra, loose, lb	.24½	
COAL TAR PRODUCTS		
Alpha-naphthol, crude, bbl., lb	$0.58	$0.60
Alpha-naphthylamine, bbl., lb	.35	.36
Aniline oil, drums, lb	.13	.13¼
Aniline salts, bbl., lb	.22	.24
Benzaldehyde, tech., dr., lb	.45	.50
Benzidine base, bbl., lb	.75	.77
Benzoic acid, USP, kegs, lb	.54	.56
Benzol, 90%, tanks, works, gal	.19	
Benzyl chloride, tech., dr., lb	.20	.21
Beta-naphthol, tech., drums, lb	.23	.24
Cresol, USP, dr., lb	.13½	
Cresylic acid, dr., wks., gal	1.00	1.05
Diphenyl, bbl., lb	16	
Diethylaniline, dr., lb	.48	.50
Dinitrotoluol, bbl., lb	.18	.19
Dinitrophenyl, bbl., lb	.22	.23
Dip oil, 15%, dr., gal	.23	.25
Diphenylamine, dr., f.o.b. wks., lb	.25	
H acid, bbl., lb	.50	.52
Hydroquinone, bbl., lb	.90	.95
Naphthalene, flake, bbl., lb	.09½	.10
Nitrobenzene, dr., lb	.08½	.09
Para-cresol, bbl., lb	.41	
Para-nitroaniline, bbl., lb	.42	.43
Phenol, USP, tanks, lb	.10½	.11
Picric, acid, bbl., lb	.30	.32
Pyridine, dr., gal	1.55	1.60
Resorcinol, tech., kegs, lb	.68	.70
Salicylic acid, tech., bbl., lb	.26	.27
Solvent naphtha, w.w., tanks, gal	.23	
Toluidin, bbl., lb	1.00	
Toluol, drums, works, gal	.23	
Xylol, com., tanks, gal	.23	
MISCELLANEOUS		
Casein, tech., bbl., lb	$.30	$.35
Dry colors:		
Carbon gas, black (wks.), lb	.04	.07
Prussian blue, bbl., lb	.42	.43
Ultramarine blue, bbl., lb	.13	.24
Chrome green, bbl., lb	.31	.40
Carmine red, tins, lb	5.50	6.00
Para toner, lb	.80	.95
Vermilion, English, bbl., lb	2.50	2.70
Chrome yellow, C.P., bbl., lb	.26	.28
Gum copal, Congo, bags, lb	.09	.55
Manila, bags, lb	.09	.15
Damar, Batavia, cases, lb	.10	.22
Kauri, cases, lb	.18	.60
Magnesite, calc., ton	58.75	
Pumice stone, lump, bbl., lb	.05	.07
Rosin, H., 100 lb	11.25	
Shellac, orange, fine, bags, lb	.63	.65
Bleached, bonedry, bags, lb	.66	.68
T. N. bags, lb	.56	.58
Turpentine, gal	1.10	

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NEW CONSTRUCTION

	Current Projects		Cumulative 1947	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	.....	.....	$895,000	$1,822,000
Middle Atlantic	$1,786,000	$235,000	4,767,000	8,890,000
South	6,300,000	450,000	8,601,000	6,644,000
Middle West	501,000	682,000	3,148,000	4,872,000
West of Mississippi	8,862,000	6,125,000	56,653,000	43,791,000
Far West	650,000	100,000	2,618,000	2,413,000
Canada	.....	1,950,000	34,956,000	3,436,000
Total	$18,099,000	$9,542,000	$111,638,000	$71,868,000

Proposed Work

Ala., Tuscaloosa—Reichold Chemicals, Inc., Tuscaloosa, plans to construct a chemical color and pigment plant on a 565 acre site Estimated cost $1,000,000.

Calif., Martinez—Shell Development Co., 100 Bush St., San Francisco, Calif., plans to construct a 1 story insecticide plant here. Estimated cost $650,000.

Ill., Chicago—Fort Wayne Corrugated Paper Co., 4500 South Kolin Ave., plans to construct a 1 story, 200x300 ft. factory. A. Epstein, 2001 West Pershing Rd., Eng. Estimated cost $225,000.

Ky., Louisville—North American Phosphate Co., 735 Bergman St., plans to construct a fertilizer plant. Estimated cost $100,000.

Mich., Detroit—Acme White Lead & Color Works, 8250 St. Aubin Ave., is having plans prepared for a varnish factory. Estimated cost $69,000.

Mich., Monroe—Monroe Paper Products Co., Monroe, plans to construct an addition to its paper mill. Estimated cost $117,000.

Miss., Clarksdale—Clarksdale Business Men's Assn., c/o J. B. Snider, plans to construct a rayon plant. Estimated cost $3,000,000.

Miss., Meridian—Berg Plastics & Die Casting Co., Meridian, plans to construct a plastics manufacturing plant. Estimated cost $2,000,000.

N. J., Gloucester—Texas Co., 135 East 42nd St., New York, N. Y., plans to construct an oil refinery. Estimated cost $1,786,350.

O., Cleveland—Industrial Rayon Corp., 9800 Walford Ave., plans to alter and construct addition to its rayon laboratory. Estimated cost $90,000.

Okla., Miami—B. F. Goodrich Co., Miami, plans to enlarge its plant here. Estimated cost $800,000.

Tex., Alice—Magnolia Petroleum Co. & Associates, Esperson Bldg., Houston, plan to construct a casinghead gasoline absorption plant here. Estimated cost $2,500,000.

Tex., Houston—E. I. du Pont de Nemours & Co., Inc., 2219 McKinney St., plans to construct a paper container manufacturing plant here to be leased to St. Joe Paper Co., Houston. Estimated cost $2,000,000.

Tex., LaPorte—E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., plans to enlarge its chemical manufacturing plant here. Estimated cost $1,500,000.

Tex., Smith's Bluff—Pure Oil Co., N. Esperson Bldg., Houston, plans to construct a 40x155 ft. soap-grease manufacturing unit, a 2 story, 156x266 ft. high pressure lubricants unit, 36x66 ft. steel drum reclamation unit, and 1 story, 156x289 ft. warehouse and loading platform. Estimated cost $900,000, $1,560,000, $91,500 and $410,000 respectively.

Va., Lynchburg—Rubatex Div. of Great American Industries, Bedford, plans to construct a plant. Estimated cost $100,000.

W. Va., Clarksburg—Rowland Glass Co., Clarksburg, plans to construct a 2 story factory addition. H. K. Ferguson Co., Hanna Bldg., Cleveland, O., Eng. Estimated cost $100,000.

Contracts Awarded

Calif., San Leandro—Dewey-Almy Chemical Co., 4000 East 8th St., Oakland, has awarded the contract for a 1 story laboratory and office building, 2 story, 32x260 ft. factory and 66x260 ft. warehouse at its plant here to Christensen & Lyons Construction Co., 3454 Harlan St., Oakland.

Ind., Fort Wayne—U. S. Rubber Co., U. S. Hy. 24, has awarded the contract for remodeling and equipping its main plant building, also constructing 3 story addition, to Wermuth, Inc., 1031 St. Mary St.

Kan., Great Bend—A. R. Jones Oil & Operating Co., Great Bend, plans to construct a gas plant here. Work will be done by owners. Estimated cost $1,000,000.

Mo., St. Louis—Monsanto Chemical Co., 1700 South Second St., will construct a power house for refrigeration plant. Work will be done by subcontracts under supervision of W. J. Knight & Co., Eng., Missouri Insurance Bldg. Estimated cost $65,000.

N. J., Rahway—Merck & Co., 126 Lincoln Ave., has awarded the contract for a manufacturing plant to Salmond Scrimshaw Construction Co., 526 Elm St., Arlington. Estimated cost $55,000.

N. D., Fargo—McKesson & Robbins, Inc., 24 North 3rd St., Minneapolis, Minn., has awarded the contract for a warehouse to Meinecke-Johnson Co., 5 North 14th St. Estimated cost $150,000.

O., Cleveland—Sheffield Bronze Powder & Stencil Co., 12405 Euclid Ave., East Cleveland, has awarded the contract for a paint factory and office building to Hamann Construction Co., 6523 Euclid Ave. Estimated cost $160,000.

O., Toledo—Owens-Illinois Glass Co., Westwood Ave., has awarded the contract for a pilot plant for study on new furnaces to George W. Lathrop & Sons, Inc., 1510 Montcalm St. Estimated cost $267,078.

Pa., Bridgeville—American Cyanamid & Chemical Corp., Bridgeville, has awarded the contract for a 1 story, 54x100 ft. laboratory to Martin & Nettrone Construction Co., Pitt Bank Bldg., Pittsburgh. Estimated cost $60,000.

Pa., Monaco—Phoenix Glass Co. has awarded the contract for a batch house at its plant here to John Klug, 760 Exchange St., Rochester, N. Y. Estimated cost $120,000.

Tex., Freeport—Dow Chemical Co., Freeport, has awarded the contract for a hydrocarbon plant consisting of 40x97x170 ft. main process building, control building, electric starter building, warehouse and office building, to J. G. Pritchard & Co., Gulf Bldg., Houston. Estimated cost $4,750,000.

Tex., Kenedy—Southwest Cotton Oil Assn., Kenedy, will improve its existing cotton oil plant and construct drying plant unit. Work will be done by force account and subcontracts. Estimated cost $69,656.

Tex., Refugio—Humble Oil & Refining Co., 1216 Main St., Houston, will construct a prefabricated gas processing plant. Work will be done by owners. Estimated cost $90,000.

Va., Richmond—Virginia-Carolina Chemical Corp., Piedmont Trust Bldg., has awarded the contract for a chemical manufacturing plant to J. Kennon Perrin, 5th and Cary Sts., Richmond. Estimated cost $450,000.

Wis., Marinette—Ansul Chemical Co. has awarded the contract for a 1 story, 100x325 ft. and 2 story, 50x150 ft. chemical plant and office building to Erling Arntzen, Escanaba, Mich. Estimated cost $200,000.

Ont., Sarnia—Polymer Corp., Ltd., Hy. No. 40, has awarded the contract for a compressor house for Ethelyene recovery unit to Canadian Kellogg Co., Ltd., 34 Adelaide St., W., Toronto, Ont. Estimated cost $1,000,000.

Que., Montreal—Dominion Rubber Co., Ltd., 550 Papineau Ave., has awarded the contract for the construction of plant units 6A and 6B to Anglin-Norcross Quebec, Ltd., 892 Sherbrooke St., W. Montreal. Estimated cost $450,000.

Que., Montreal East—McColl-Frontenac Oil Co., Ltd., 360 St. James St., Montreal, has awarded the contract for an addition to its refinery to Canadian-Kellogg Co., Ltd., 34 West Adelaide St., Toronto. Estimated cost $5,000,000.

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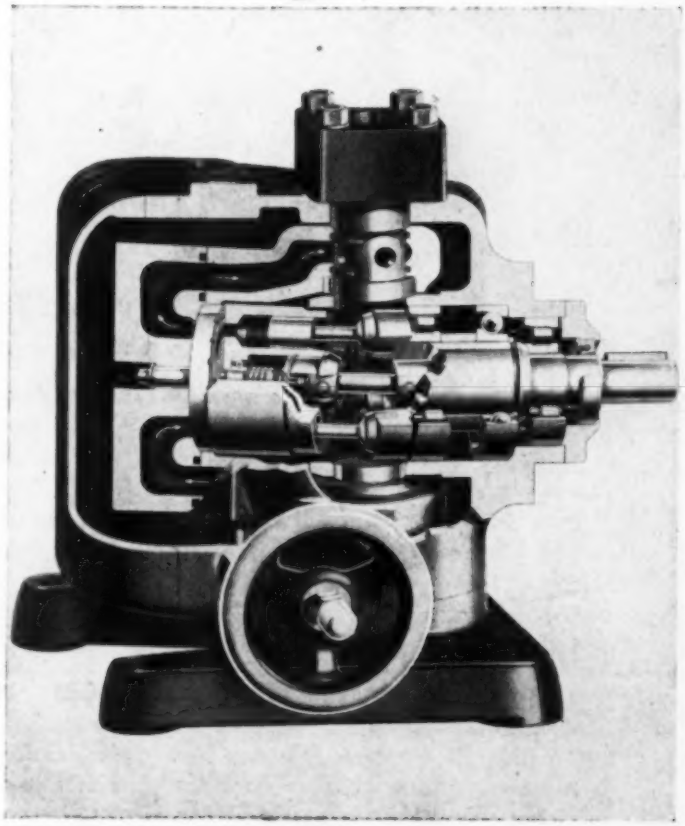

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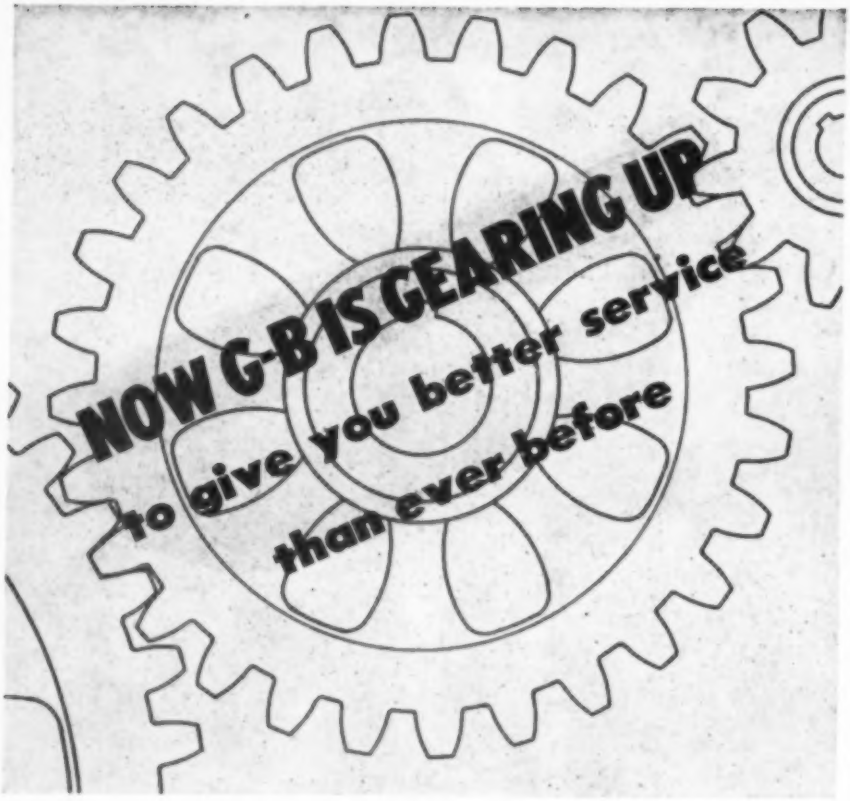

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1950-1960

The Twentieth Century Fund, a privately-endowed research foundation, has just completed a monumental 875-page work called "America's Needs and Resources." In it is presented a detailed preview of what economic life in the U. S. A. during the 1950-60 decade will be like if we succeed in maintaining high-level employment. From the findings of the Twentieth Century Fund survey, the McGraw-Hill Department of Economics has prepared this synopsis, which highlights points of interest to readers of this magazine.

1940
1950
1960
MORE PEOPLE WORKING . . .
EACH PRODUCING MORE . . .
CAN TURN OUT ENOUGH GOODS AND SERVICES . . .
FOR CONSUMERS, CAPITAL INVESTMENT AND GOVERNMENT
WITH THE RESOURCES AVAILABLE . . .
TO MEET ALMOST ALL OUR NEEDS
NEEDS
PRODUCTION

POPULATION

A nation's wealth depends more than anything else on the size and vigor of its population. Much of the increase in U. S. production during the past hundred years is a result of a rapid growth in population. This growth supplied manpower for farms and factories and provided an expanding market for consumer goods and services.

MORE PEOPLE WORKING . .

Growth was the outstanding fact about population before 1930. The birth rate was almost double the death rate and there was a heavy flow of immigrants. Between 1900 and 1930, the population increase averaged 15 million each decade. Immigration contributed a third of the increase.

But this trend was checked by the depression 30's which stemmed the flood of immigrants and cut the birth rate by forcing postponement of many marriages. As a result, fewer than 9 million persons were added to the population between 1930 and 1940. This was an important factor in prolonging the depression because it slowed the growth of consumer markets.

WARTIME MARRIAGE BOOM

War and postwar conditions have brought a boom in marriages. They have exceeded normal by more than 1,500,000 since 1940. There will be more newly-married couples in 1950 than ever before and the birth rate may be roughly 10% higher than in the early 1930's. So the 20th Century Fund looks for an increase of 12 million in total population between 1940 and 1950 and a further increase of 10 million in the 1950's.

This will mean a faster-growing market for homes, autos, food, clothing, and other consumer items than we had in the 1930's. It will mean crowded schools and more people seeking jobs.

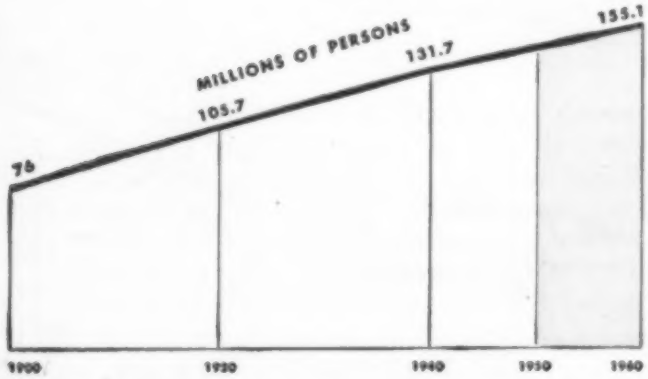
There are four major population trends which will affect markets in the 1950's:

1. The number of families will continue to increase more rapidly than the number of people as families grow smaller. This is significant because the market for housing, appliances, and many other things depends more on the number of families than on the number of people.

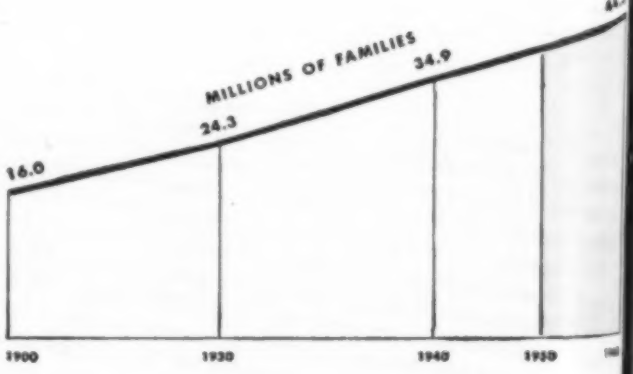
2. Our population will be getting older. But it will not be getting less productive because the proportion of the population between the ages of 20 and 60 will be higher than in past decades. Still, the most striking increase will take place in the number of people over 60—from 14 million in 1940 to more than 20 million in 1960. This will bring greater demand for medical services and social security. An important cause of this trend is our success in controlling communicable disease. The following table shows how the death rate from selected causes has changed since 1900.

	Death Rate Per 100,000 Persons	
	1942	*1900*
Diseases of heart	295	137
Cancer and other malignant tumors	122	64
Influenza	56	202
Tuberculosis	43	194
Diarrhea and enteritis	9	143
Whooping cough	2	12
Diphtheria	1	40
Measles	1	13
Typhoid and paratyphoid fever	0.5	31
Scarlet fever	0.3	10
Other	505.2	873
	1035.0	1719

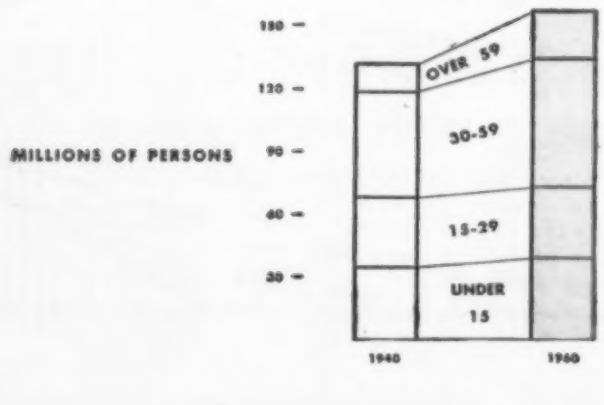
TWICE AS MANY PEOPLE



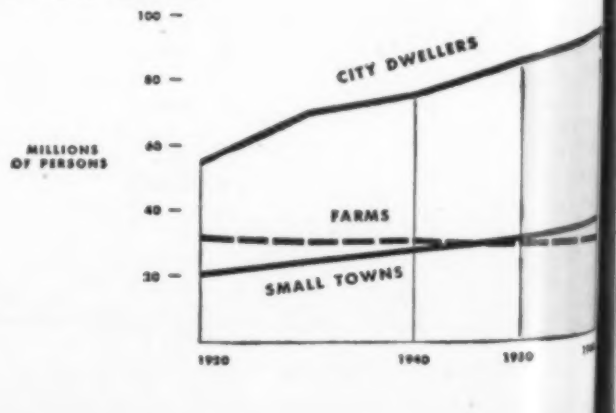
BUT THREE TIMES AS MANY FAMILIES



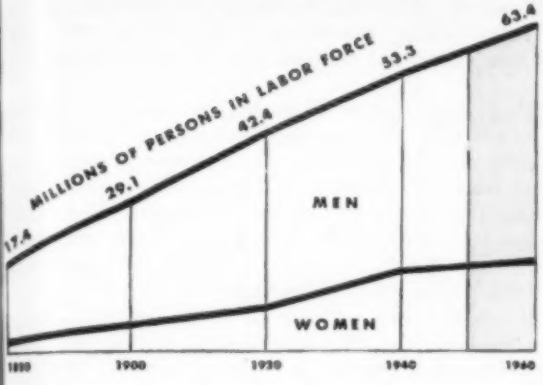
MORE OLDER PEOPLE



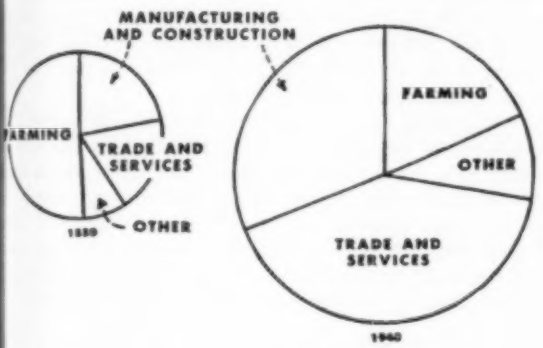
MORE CITY DWELLERS



MORE AND MORE WOMEN ARE SEEKING JOBS

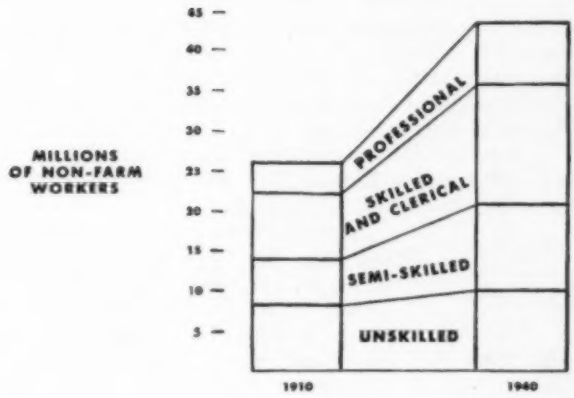


FARMING IS GIVING WAY TO OTHER OCCUPATIONS



ANATOMY OF THE LABOR FORCE

THE LABOR FORCE IS GROWING MORE SKILLED



3. The population will continue to become more urbanized. Small and medium-sized cities will grow faster than the largest cities. The general westward migration which was accelerated by the war will continue.

4. Our people will keep on getting more homogeneous. There has been almost no immigration since 1929, so the number of immigrants who have been in the country for less than 20 years will make up less than one percent of the population in 1950 as against 10% in 1930.

An even more important factor in making the population all of a kind has been the growth of universal education. The proportion of children 14-17 years old attending high school doubled between 1920 and 1936. The rise of the radio, movies, and national magazines has also levelled us out. These developments not only raise the general educational level of the nation but also tend to standardize the public's tastes and attitudes.

LABOR FORCE

The volume of goods and services produced by 145 million persons in 1950 and 155 million in 1960 will depend on what share of the population is in the labor market and the amount of work those employed actually do. The proportion of the population in the labor force has shown little change in the past few decades. So the 20th Century Fund assumes that the relationship between labor force and population will be about the same in 1950 and 1960 as it was just before the war. On this basis 60 million people will be in the labor market in 1950 and 63.4 million ten years later.

As you can see from the charts, however, there will be several important changes in the composition of the labor force. More women will be working. In 1870 only one out of every eight worked. By 1940 the proportion had grown to one out of four, and evidently will go on rising.

However, the increase in the number of women working will just about be offset by earlier retirements and longer schooling. This explains why there is little change in the ratio of labor force to population.

UNEMPLOYMENT

The effectiveness of the labor force depends not only on its size but on how fully it is employed. We have never had full employment in the sense that everyone able and willing to work had a job at the same time. Even in good years unemployment has seldom averaged less than 5% of the working force because workers are always moving from job to job. And in 1932, nearly one-fourth of all workers were unable to find jobs.

For this reason, the 20th Century Fund assumes that, even with good business in the 1950s, unemployment will average 5% of the labor force. This works out to 3 million unemployed in 1950.

In addition, the Fund expects the long down-trend in average weekly hours to continue. A century ago, workers put in a 12 hour day for 6 days a week. By 1940 the average work-week had declined to 44 hours in non-agricultural jobs and 52 hours in agriculture. If this trend continues, the average in non-farm jobs will be down to 38 hours a week in 1960, and farmers will work 48 hours.

Adding all this up, and allowing for vacations, absenteeism, and sickness, the 20th Century Fund estimates that the U. S. will put in 121 billion man-hours of work in 1950 and 118 billion in 1960. This compares with 105 billion in 1940 and with 154 billion at the peak of the war effort. The quantity of goods and services that can be turned out with this amount of labor effort will depend on average output per man-hour, or productivity.

PRODUCTIVITY

The key to our future economic welfare is productivity. It is the five-fold increase in output per man-hour that has made it possible for us to work shorter hours and still enjoy a rising standard of living. This increase in productivity has been accomplished not by working harder but by constantly inventing better machinery to supplement human energy with mechanical power.

Of course, in any specific factory at any given time, productivity depends largely on the willingness and ability of labor and management. But over the years, the actual effort of the individual worker becomes much less important than the effort of the machine. The most energetic and skilled blacksmith of a century ago could not remotely approach the productivity of today's semi-skilled worker operating automatic power-driven equipment.

EACH PRODUCING MORE . . .

In 1860, the average worker turned out 33¢ (in 1944 dollars) worth of goods in an hour. By 1940, this had grown to $1.22. This sensational increase in productivity was due to the increased use of power-driven machines. In 1860, the average worker had the help of only half a horsepower of animal or mineral energy. In 1940, he had the use of 2.7 horsepower. To put it another way, if there had been no increase in the use of mechanical power since 1850, it would have taken 290 million workers to turn out the amount of goods and services actually produced at the peak of the war effort by only 63 million workers.

DO MACHINES KILL JOBS

Past history also shows that we need not fear the long run effects of the introduction of labor-saving machines. On the contrary, the only way we can improve the material welfare of everyone is to continue and even step up the rate at which we save labor by using machines.

Some people, it is true, are thrown out of work and a few of them may not be able to find other jobs easily. But mechanization more than compensates for "technological unemployment" by making it possible to produce more and better things for everyone—things that themselves create jobs. Development of the railroads and the automobile, for example, put a lot of canal boat and livery stable operators out of business. But it cut the cost of transportation and created many times more jobs than it eliminated.

The 20th Century Fund also points out that the most important reason that the technological revolution developed luxuriantly in the U. S. between 1850 and 1940 was that competitive enterprise provided a generally favorable climate. It is true that natural resources were plentiful and that the population was growing rapidly both in numbers and in skill. But what we had to a unique degree here was an atmosphere which favored risk-taking, fostered the vast capital investment necessary to harness and apply mechanical energy, and provided the incentives necessary to put capital and inventiveness to work.

No other economy has equalled ours in the ability to produce more and more with continually diminishing human effort. The test it now faces is whether it can eliminate the ups and downs in production and employment that have gone along with it. But an abundance of evidence indicates that we ran into trouble after 1929 not because we developed too many labor-saving machines but because we didn't adjust our economic mechanism to keep the process going.

The key importance of mechanization is indicated by the fact that the increase in national production since 1860 closely parallels the increase in use of mechanical power. Between 1860 and 1940, both volume of production and use of energy multiplied about 11 times. It is clear that, in order to keep our standard of living rising, we must continue to apply more and more power to production.

Chief advantage of mechanical energy is, of course, its low cost. Electric energy is now delivered for as little as a cent a horsepower, while the same amount of human energy costs $10.

And there are other important advantages. Mechanical energy can be delivered in greater concentration than any other form. It is also more convenient, compact, mobile, and controllable. Consolidated Edison in New York delivers enough electricity in a day to do the work of 3 million draft horses.

These advantages are now so universally accepted that it's hard to realize how recently we left the horse and buggy era. At the turn of the century, animals and men provided more than half the energy used in production and transportation. It wasn't until World War I that trucks replaced horses in local hauling and tractors began to invade the farms. Here is how the use of mechanical energy has grown since 1850:

	Total Energy Output (Billions of Horsepower-Hours)	Percent Supplied by:		
		Mechanical Energy	Humans	Animals
1850	17.6	6	15	79
1860	25.2	7	14	79
1870	27.8	12	15	73
1880	39.9	17	14	69
1890	61.1	28	12	60
1900	82.9	38	10	52
1910	131.4	57	8	35
1920	197.4	73	6	21
1930	238.3	84	5	11
1940	289.4	90	4	6
1950	410.4	94	3	3
1960	489.8	96	2	2

PRODUCTIVITY IN THE FUTURE

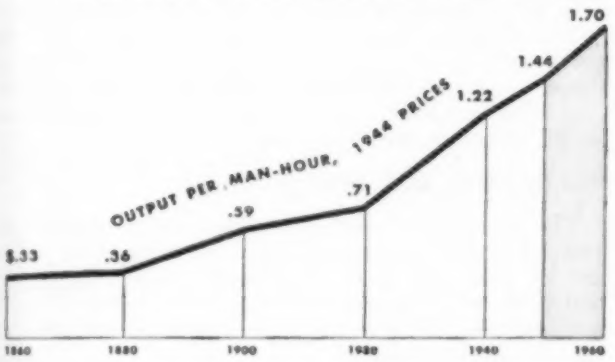
Any attempt to predict future developments in productivity is complicated by the fact that the changes do not occur at an even rate. Between 1850 and 1940 the average increase in output per man-hour was 18% per decade. But the changes varied all the way from 3% between 1870 and 1880 to 42% for the decade ending in 1940. There is, therefore, no simple way to extend past trends to obtain a foolproof figure for productivity at a future date.

For purposes of this study, however, the 20th Century Fund assumes that the average rate of increase since 1850 may be projected to estimate output per man-hour in 1950 and 1960. Thus, output per man-hour works out to $1.44 in 1950 and $1.70 in 1960 against $1.22 in 1940 (all in 1944 dollars).

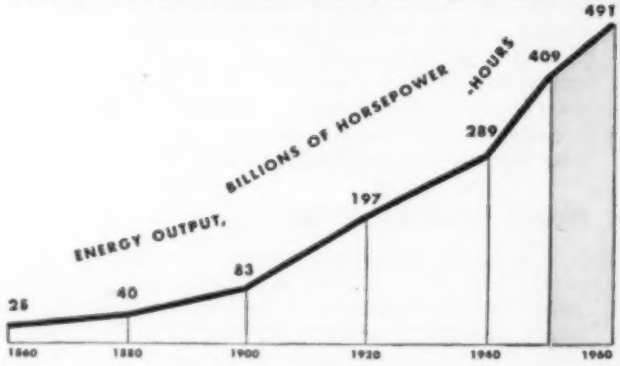
As the Fund points out, this is a critical assumption, and it is further complicated by the fact that there is a wider possibility of error in this estimate than in most of the others in the study. If, for example, it is assumed that productivity will increase at the pace set from 1920 to 1940 which averaged 36% per decade, then 1960 production would be about double the 1940 level instead of only 157% of it, the 20th Century Fund estimates.

A CENTURY OF ECONOMIC PROGRESS 1860–1960

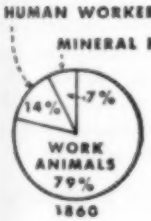
OUTPUT PER MAN-HOUR SHOULD BE 5 TIMES AS GREAT

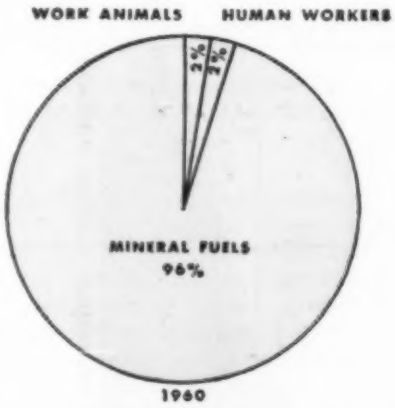


BECAUSE OF A STEADY GROWTH OF POWER AND MACHINES

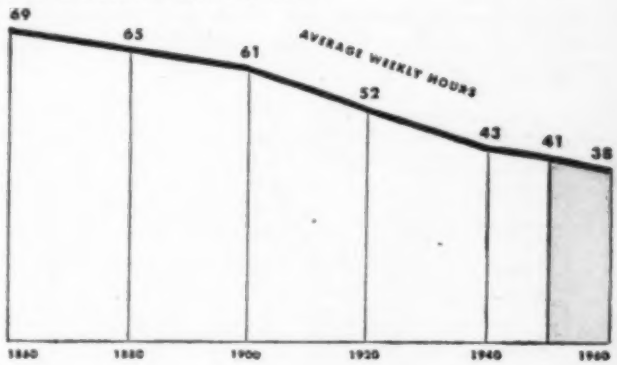


SO WITH LESS EFFORT

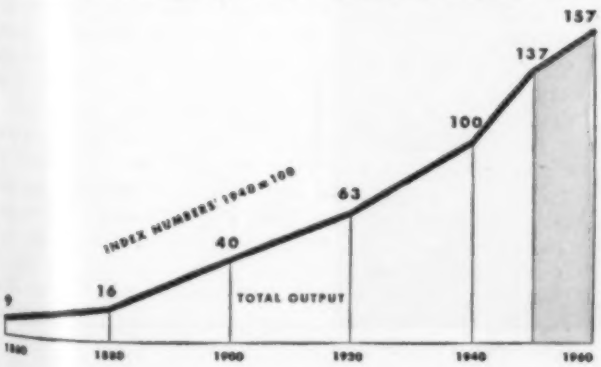




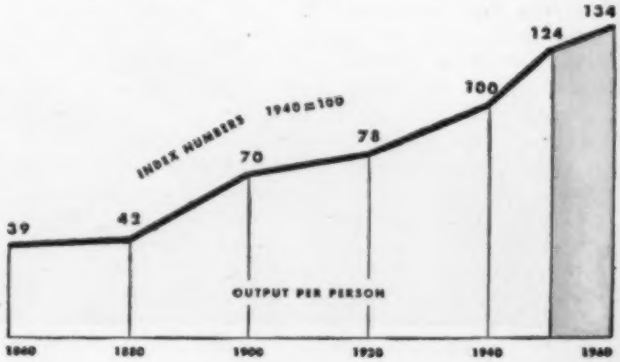
AND A SHORTER WORK WEEK



6 TIMES AS MANY WORKERS CAN PRODUCE 17 TIMES AS MUCH



AND PROVIDE 3½ TIMES AS MUCH OUTPUT FOR EACH PERSON



TOTAL NATIONAL OUTPUT

The potential volume of goods and services in 1950 and 1960 can be determined by simple arithmetic, using the assumptions outlined on the preceding pages. Of an estimated population of 145 million in 1950, about 60 million persons will be in the labor market and 57 million of them will have jobs if we succeed in keeping business activity at a high level.

This many people would work 121 billion man-hours. With output per man-hour estimated at $1.44 (in 1944 dollars) the total value of goods and services produced, or the gross national product, would come to $177 billion. Similar calculations yield a gross national product of $202 billion for 1960.

As the 20th Century Fund emphasizes, these estimates are neither a forecast of actual production nor an appraisal of maximum potential production. They are merely an attempt to show in dollars and cents what can be achieved with high-level employment.

HIGHER LIVING STANDARDS

Compared with any prewar year, a gross national product of $177 billion in 1950 and $202 billion in 1960 would represent a handsome gain. It would make possible a substantial rise in living standards. In 1950 we would produce a fifth more than in 1941.

CAN TURN OUT ENOUGH GOODS AND SERVICES . . .

However, the volume of goods and services turned out in 1950 would be only slightly higher than present production. This is because the number of persons at work today is 2 million above the estimated normal for 1950, and average weekly hours are higher than they will be then. Almost a million and a half of the emergency workers drawn into the labor force during the war are still at work and unemployment is lower than the figure assumed for 1950.

The estimates of 1950 and 1960 gross national product, as well as the figures for past years used in the chart, are expressed in 1944 prices. This is not a prediction that the price level will settle down to the 1944 level which would involve a drop of 18% in the cost of living and 26% in wholesale prices. It is merely a device to eliminate price fluctuations so that the figures will show only the actual changes in the physical volume of production.

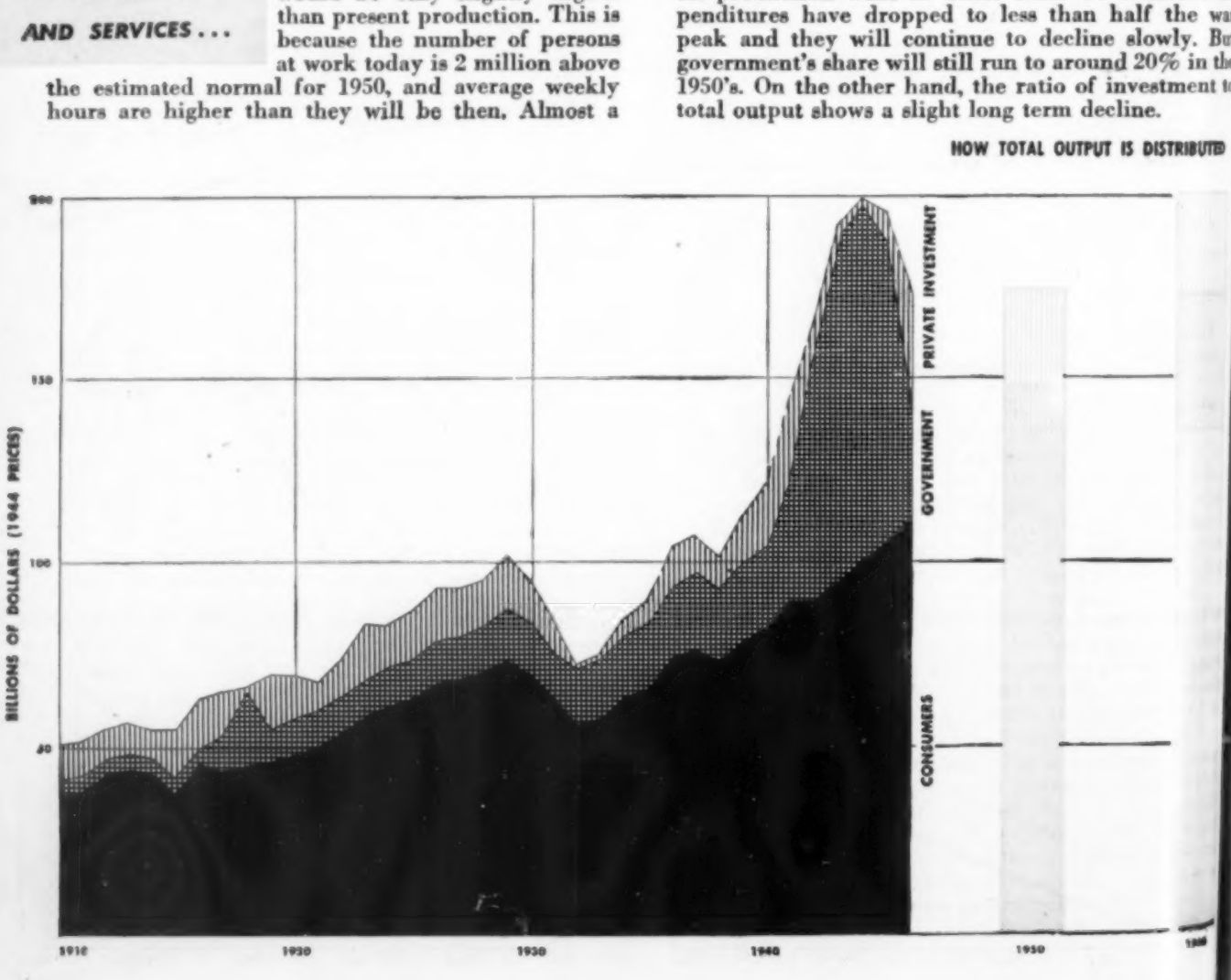
Gross national product measures the total market value of everything the nation produces. All the goods and services produced are absorbed in one of three ways: by consumer expenditures; by expenditures for investment in capital goods or inventories; or by government expenditures.

HIGHER TAXES, LESS INVESTMENT

The division of total output among consumers, investment, and government will be somewhat different in 1950 and 1960 than in the past. About two-thirds of total output will go into consumer goods and services. This is about the same as the proportion in prewar years.

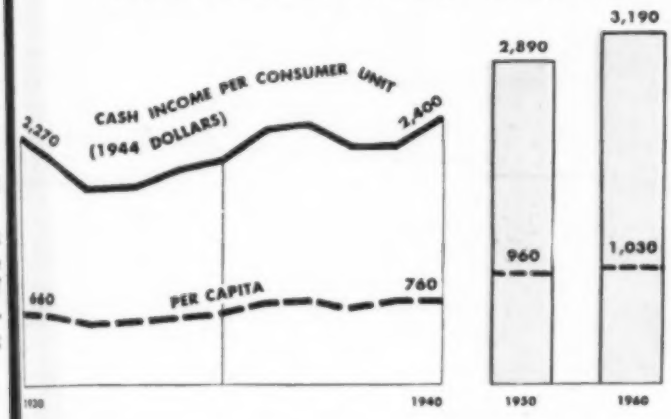
Government's share will continue to grow, however. It rose from 11% of total output in 1929 to 17% in 1940. At the peak of the war effort, half of all production went to Uncle Sam. Government expenditures have dropped to less than half the war peak and they will continue to decline slowly. But government's share will still run to around 20% in the 1950's. On the other hand, the ratio of investment to total output shows a slight long term decline.

HOW TOTAL OUTPUT IS DISTRIBUTED

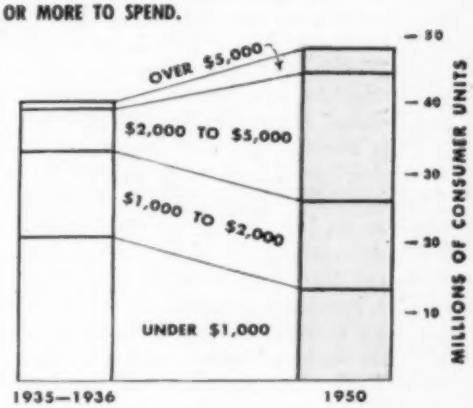


MORE CONSUMER PURCHASING POWER

CONSUMERS WILL BE ABLE TO BUY 50% MORE THAN IN 1930'S



EVERY OTHER FAMILY... INSTEAD OF EVERY SIXTH FAMILY... WILL HAVE $2,000 OR MORE TO SPEND.



CONSUMER INCOME

U. S. business can look forward to a 1950 consumer market twice as large as in the worst year of the depression, half again as large as in 1929, and one-fifth larger than in 1941. That is the major conclusion of the 20th Century Fund's analysis of consumer purchasing power. Here are the steps by which it arrives at that conclusion:

1. With gross national product at $177 billion in 1950, past experience indicates that income payments to individuals would run to $138 billion.

2. Income tax rates are assumed to equal the 1942 schedules, so individuals would pay $11 billion in taxes (as against $19 billion in 1946).

3. Savings are estimated at $12 billion, or about 9% of income after taxes.

4. Subtracting taxes and savings, consumer purchases of goods and services would total $116 billion.

LOWER SAVINGS

Many experts would criticize the assumption that savings will amount to only 9% of income. Some of them look for a ratio as high as 20% in prosperous postwar years. The 20th Century Fund justifies the use of a low figure on three grounds: (1) people built up reserve of savings during the war; (2) expanding social security will reduce the need to save for old age; and (3) taxes will cut into savings. The Fund's estimate of savings plus taxes in 1950 adds up to a higher percentage of income than in prosperous prewar years.

The standard of living won't rise as rapidly as the total income going to consumers, because the increased income will be split up among more family units. But the average consumer unit (a family or a single person living alone) will be a third better off in 1960 than in the 1930's.

Shifts in the distribution of income will be even more important, from a marketing standpoint, than the general increase in over-all consumer income. More consumer units will be in the over-$2000 brackets than ever before and this group will be receiving a much larger share of total consumer income.

Part of the apparent increase in income is cancelled out by higher prices. To show the actual increase in purchasing power, the figures should be adjusted for an estimated one-third increase in the 1950 price level over that of the mid-1930's. This would mean that a $2,650 income in 1950 would buy no more than a $2,000 income in 1935-36. Even if this adjustment is made, the resulting figures still show a striking upward shift.

Income Class	Consumer Units in Millions		Cash Income in Billions	
	1935-56	1950	1935-36	1950
Total	39.2	47.9	$85.0	$135.0
Under $1000	20.8	13.0	17.0	7.7
$1000-2000	12.2	12.9	28.1	21.5
$2000-5000	5.5	18.2	23.8	62.1
Over $5000	0.7	3.8	16.1	43.7

FOR CONSUMERS...

In addition to dollar income, shown in the above table, consumers also receive "income in kind"—food and fuel produced by farmers for their own use, board and lodging received by domestic servants. Such income will have a value estimated at $3.3 billion in 1950, most of which will supplement the $7.7 billion received by those in the "under $1000" bracket.

The urban market will continue to be far more important than the rural market. Consumer units in cities will receive cash incomes of $3,445 on the average in 1950, more than twice the farm average of $1,635 and almost twice the small town average of $1,880.

THE FARM MARKET

These figures don't provide an accurate measure of the relative importance of the rural and urban markets because rural consumers pay a lot less for food, fuel, shelter and so have more to spend for other things. If there were any way to adjust for these things, the figures would show a smaller spread between the two markets, but the urban market will still be dominant.

All these figures underline a general upgrading in consumer demands which would accompany high-level production and employment. It will have a profound effect on marketing practices. The average person will eat better, dress better, and live in a better house with better equipment. And he will have more money to spend for travel, recreation, and luxuries.

CONSUMER MARKETS

The improvement in living standards during the 1950 decade will lead to important changes in the way consumers spend their dollars. Even though they will eat better, dress better, and live in better houses, a smaller share of the consumer dollar will be spent on food, clothing and shelter. A growing share will go for appliances, furniture, travel, and recreation.

This means that the fastest growing markets will be those providing what might be called "optional" goods and services — things which add to comfort and enjoyment but which are not strictly necessary. Markets for necessities, on the other hand, will expand at a slower rate than total consumer expenditures.

The growing importance of "optional" goods and services is one of the reasons why it's increasingly difficult to keep our economic machine going on an even keel. The purchase of "optional" goods can be postponed with little hardship. So anything that causes people to put off buying a new car, a new house, or a new radio has a far greater effect on production and employment now than it did when the major share of the consumer dollar went for necessities.

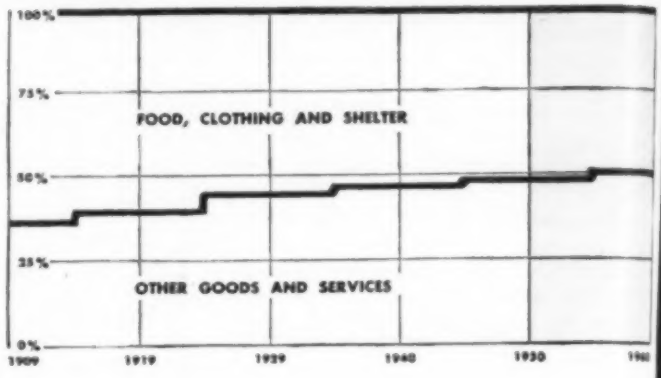
Some of the trends in major markets are summarized in the following sections.

FOOD

Although food is by far the largest item in the consumer budget, its relative importance is declining slowly as living standards rise. People eat the same number of pounds of food they ate in 1909 but the food is better from a nutritional standpoint and easier to prepare. Thus, the trend favors fruits, vegetables, and dairy products as against meat, potatoes, and bread.

More and more food is being processed in factories rather than in consumer kitchens. Improved methods of manufacture and distribution have transformed the luxury foods of yesterday into the standard foods of today. New kinds of processed foods — canned, frozen, and dehydrated — are appearing constantly.

STANDARD OF LIVING YARDSTICK: MORE OF THE CONSUMER DOLLAR GOES FOR THE COMFORTS OF MODERN LIFE



CLOTHING

Three long term trends will shape the clothing market in the future: (1) the shift from home and custom to factory fabrication is almost complete

WHERE CONSUMER DOLLARS GO

(Figures in Billions of Dollars)

	1909	1919	1929	1940	1941	(1944 Prices) 1950	1960
Total Consumer Expenditures	28.8	60.8	80.3	70.6	80.4	116.2	134.2
Food, Liquor, and Tobacco	9.9	22.3	23.7	21.9	25.3	36.2	41.1
Food	7.4	18.8	19.9	16.4	19.0	27.2	30.8
Liquor and Tobacco	2.5	3.5	3.7	5.5	6.3	9.0	10.3
Clothing and Personal Care	4.4	9.8	12.1	9.8	11.5	16.2	18.7
Housing	6.8	10.1	14.4	12.6	13.3	19.3	21.4
Rent a.	5.5	7.9	11.3	9.1	9.7	14.0	15.4
Fuel	1.0	1.5	1.7	1.7	1.8	2.5	2.8
Electricity	0.1	0.3	0.6	0.9	1.0	1.6	1.8
Household Equipment and Operation	2.8	6.2	10.6	8.7	10.3	15.0	17.4
Appliances	0.2	0.4	0.8	1.0	1.3	1.8	2.4
Consumer Transportation	1.6	5.2	8.6	7.3	8.6	12.7	16.4
Autos and Private Planes b.	0.6	3.5	6.0	5.7	6.8	9.6	12.7
Local Bus and Street Car	—	—	0.8	0.7	0.8	1.5	1.5
Intercity Bus	—	—	0.1	0.1	0.2	0.2	0.2
Airlines	—	—	c.	c.	c.	0.1	0.5
Railroads	0.4	0.8	0.6	0.3	0.3	0.4	0.3
Medical Care, Insurance, and Death Expenses	1.1	2.8	4.5	4.7	5.2	7.7	8.7
Recreation	0.9	2.1	3.8	3.3	3.7	5.7	6.9
Radio and Television Sets	0.2	0.7	1.0	0.6	0.8	1.1	1.3
Private Education, Religion, and Welfare	1.2	2.2	2.7	2.3	2.4	3.4	3.7

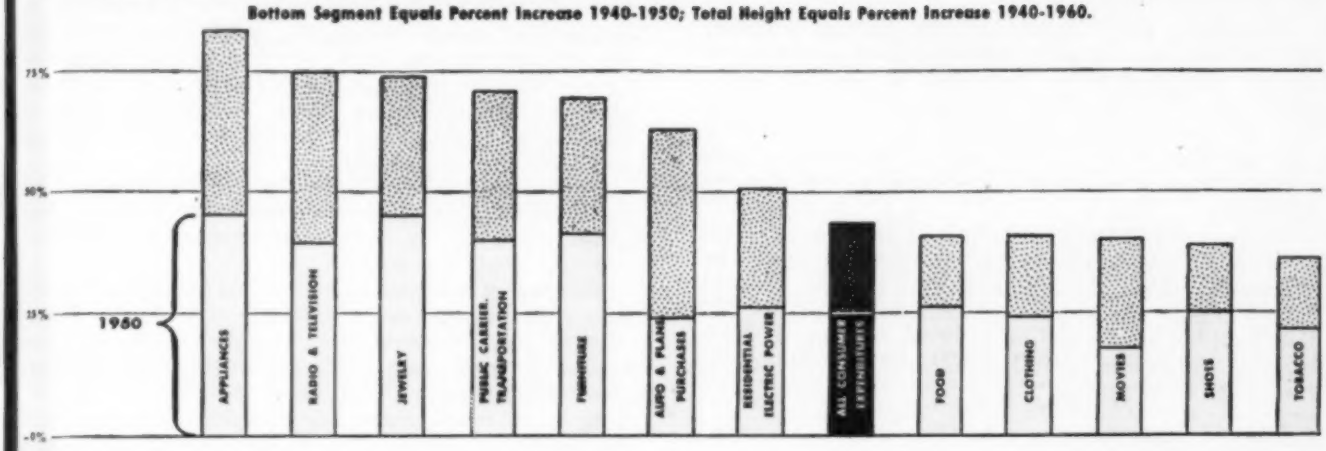
a. Includes Estimated Rent for Owner-Occupied Homes.

b. Includes Original Cost and Operating Expenses.

c. Less than $50 Million.

CONSUMER MARKETS IN 1950 AND 1960: Percent Increase in Sales Over 1940

Bottom Segment Equals Percent Increase 1940-1950; Total Height Equals Percent Increase 1940-1960.



(2) synthetics, chiefly rayon and nylon so far, are replacing cotton, wool, and silk at an accelerating pace; (3) there's greater standardization of styles and a trend to lighter and simpler clothing.

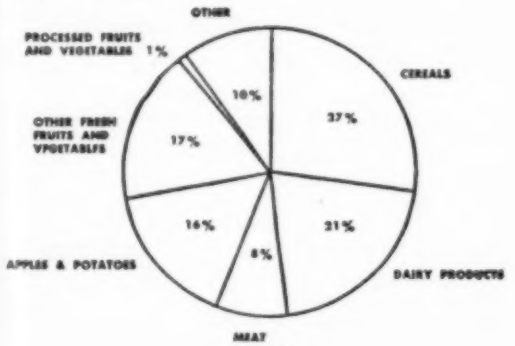
In 1909 consumers spent 14% of their income for clothing but by 1940 the ratio had reclined to 12%. However, this long run decline may be halted or reversed. The migration from farms to cities, the upgrading of incomes, and the growing demand for sports clothing will increase clothing expenditures.

HOUSING

The decline in the relative importance of housing expenditures — from 24% of consumer dollars in 1909 to less than 18% in 1940 — is expected to continue. The reason is that people feel they get more value for their dollars in other things than housing. Nevertheless, the housing market should be much larger in the 1950's than in the 1930's because much of our housing needs to be repaired or replaced.

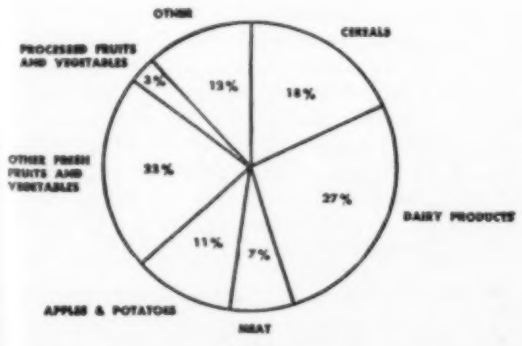
A Census survey in 1940 showed that 16 million of the nation's 37 million dwelling units needed to be replaced or needed major repairs. The 20th Century Fund estimates that the provision of adequate housing for everyone by 1960 would involve building 20 million new units and rehabilitating 5.4 million at a total cost of $115 billion (1944 prices). The Fund also estimates that we will fall 15% short of this goal even with continued high-level employment.

OUR CHANGING DIET: MORE MILK, FRUITS AND VEGETABLES LESS MEAT, POTATOES AND BREAD



1909

1880 POUNDS OF FOOD PER PERSON



1939

1882 POUNDS OF FOOD PER PERSON

HOUSEHOLD EQUIPMENT

More and more of the consumer dollar has gone for household equipment in the past four decades, largely because of the development of labor-saving appliances. The outlook is for a continuation of this trend. New appliances are being developed; and the large number of new houses slated to be built in the next few years, the wartime and postwar boom in the number of families, and the migration to the cities should add to appliance demand. The same factors should brighten the outlook for furniture, rugs, and other household items.

Some appliance markets may be saturated by the 1950's, however. A few years of high production would fill our homes with refrigerators, for example. However, replacement demand would run to 2.7 million units in 1960 and there would be a demand for 1.3 million refrigerators to equip new houses, so the market would still be bigger than in 1941 when 3.6 million were sold. However, new products must be developed if the industry is to keep up the pace it has set in the past.

TRAVEL

In 1916 the average person traveled 400 miles. By 1940 the average had grown to 2,400 miles, chiefly because of the rise of the automobile. The 20th Century Fund expects this growth to continue because as their incomes rise people spend more money traveling.

A good share of the increased spending will go to purchases of cars and planes. The Fund estimates that there will be 36 million cars on the road and 100,000 private planes in the air in 1950. The auto industry would be able to sell 5 million new cars a year after 1950 — 4 million for replacement and a million for population growth.

CAPITAL INVESTMENT

Investment plays a crucial role in our economy for two reasons. It is by plowing back part of our annual output that we are able to provide better machines and equipment to keep productivity rising. But the amount ploughed back varies widely from year to year. This unevenness of capital investment contributes to the instability of production and employment.

Because capital investment involves the purchase of durable goods, it can be postponed almost indefinitely when the outlook for profits darkens. Thus, capital investment plummeted from $18 billion in 1929 to $5 billion in 1933, a drop of 72%, whereas consumer spending fell only about half as fast in the same period.

MORE FOR EQUIPMENT

There has been an important shift in the relationship between construction and equipment, the two major types of investment. Before World War I, construction made up around three-fourths of total investment but the ratio declined to less than half in 1935-39. Part of the decline is, of course, explained by the fact that the depression left us with ample plant capacity but provided an incentive to buy more efficient machines to cut costs. Nevertheless, there is a well-defined trend towards allocating an increasing proportion of investment to equipment rather than to plant construction.

CAPITAL INVESTMENT . . .

A little less than two-thirds of total investment goes into industrial plants and equipment. Housing and other consumer construction (hospitals, schools, churches) averaged 27% of total investment during the interwar period. Housing fell from a peak of $6 billion in 1926 to $4.7 billion in 1929 and $600 million in 1933; and it had recovered only half the 1926 volume by 1940.

While other types of investment follow the ups and downs in general business, investment in housing construction follows a cycle of its own. This housing cycle is determined by factors such as the vacancy rate, the level of rents, and that of construction costs, which may not follow the trend of general business. When a drop in general business activity takes place during a declining phase of the housing cycle, as it did in 1929, the result is a deep and prolonged depression.

Government investment, of which the largest component is highways, has been much more stable than other types but it doesn't swing enough weight to stabilize total investment.

Because of the wide fluctuations in capital investment, it's much more difficult to estimate future capital expenditures than future consumer purchases. In order to make a relatively stable forecast, the 20th Century Fund bases its estimates on the long term trend since 1879, which shows a slight decline in the share of total output going to capital investment. Thus, investment under conditions of stable prosperity in the 1950 decade is estimated at 16% of total output as compared with a ratio of more than 18% in the late 1920's. On this basis, estimated capital expenditures work out to $28 billion for 1950 and $33 billion in 1960. Our ability to maintain high employment and rising living standards will depend in large measure on our ability to invest that much profitably in new machinery and buildings.

CAPITAL NEEDS

Analysis of our capital needs lends little support to the idea prevalent during the 1930's that we had reached economic maturity so that there was no way to invest as much as we had in earlier decades. No one has ever made an estimate of how much it would cost to modernize our industrial plant, which is valued at around $200 billion at prewar prices. If as much as a third of it needs to be replaced or rehabilitated, around $100 billion (current prices) of additional investment will be required.

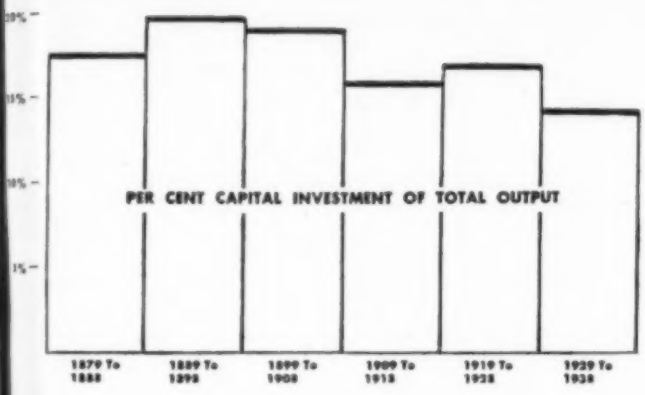
In addition, huge amounts of money need to be invested in housing and public works to raise the serv-

WHERE INVESTMENT DOLLARS GO

(Figures in Billions of Dollars)

	(Annual Averages)					(1944 Prices)	
	1920-1924	1925-1929	1930-1934	1935-1939	1940-1944	1950	1960
Total Capital Investment	$12,428	$17,186	$8,215	$10,445	$12.340	$27,700	$33,000
All Industries	7,570	10,112	5,272	6,889	8,089	17,800	21,125
Manufacturing	1,996	2,362	1,074	1,610	3,731	4,200	5,025
Food	261	357	194	244		228	273
Textiles	227	212	92	117		175	210
Steel	138	188	110	192		853	1,021
Autos	105	150	78	146		369	441
Chemicals & Petroleum	70	95	68	142		928	1,111
Machinery	—	—	—	28		180	216
Other	510	625	213	409		1,462	1,750
Transportation	1,797	2,303	1,277	1,822	805	4,300	5,100
Commercial	1,196	1,940	777	719	833	1,950	2,300
Utility	693	999	483	422	780	1,500	1,625
Other	1,888	2,508	1,661	2,316	1,940	3,950	4,700
Consumer Construction	3,806	5,557	1,547	2,256	2,912	7,200	8,255
Government Construction	1,052	1,517	1,396	1,299	1,338	2,700	3,620

OVER THE YEARS ABOUT 1/5 OF TOTAL OUTPUT IS PLOWED BACK AS INVESTMENT



BUT THE AMOUNT PLOUGHED BACK VARIES GREATLY FROM GOOD YEARS TO BAD, ACCENTUATING THE SWINGS OF THE BUSINESS CYCLE

ices provided merely to adequate levels. The 20th Century Fund estimates that the cost of a 15 year program to modernize our city streets and rural highways would run to $40 billion. To bring the nation's housing up to minimum standards of health and decency by 1960 would cost $115 billion. To conserve our natural resources and develop our water power would cost $27 billion over a 15 year period.

There seems to be little question that needs exist for all the capital investment we can make for a long time to come. The behavior of investment in the past strongly suggests that the problem is not one of lack of needs but one of finding ways to add to our capital in an orderly fashion. Capital investment has followed the boom and bust route in the past; what is wanted is a high but steady rate of investment.

WARTIME INVESTMENT DEFICIT

Demand for capital goods is stronger right now than ever before, largely because of the backed-up needs arising out of the war. Here is how wartime expenditures for capital goods which can be used in peacetime production compared with expenditures in the last 5 years of both the 1920's and 1930's: (Figures in billions of dollars)

	1925-1929	1935-1939*	1940-1944
Total Capital investment	$86	$65	$49
Industrial	51	43	32
Manufacturing	12	10	14
Metals, chemicals, machinery, petroleum	6	6	11
All Other	6	4	3
Commercial	10	5	3
Railroads	5	3	3
Electric power	5	3	3
Consumer Construction	28	14	12
Public Works	7	8	5

*Adjusted to Wartime Prices

Wartime restrictions held investment in all civilian lines far below what would be spent in prosperous peacetime years. Thus, there was a backlog of investment needs at the end of the war which ran to more than $30 billion, if the 1925-1929 demand can be taken as typical. Whatever the precise size of the backlog, it is clearly great enough, when added to the normal yearly demand for new investment, to keep the heavy goods boom going for some time to come. The test of our ability to stabilize capital investment will come later.

There is also a huge foreign demand for American capital. How far we will go toward meeting this depends largely on whether international political and economic conditions are stable enough to make private foreign investment a good risk.

If we invest abroad in the same proportion we did in the late-1920's, our foreign investments will total $1.6 billion during the year 1950 and $1.5 billion in the year 1960. This will mean a net increase in our foreign holdings of $15 billion during the 1950's, raising the total of such holdings to about $25 billion, as against a total of $10.6 billion in 1940.

To make that much foreign investment pay out, an expanding volume of world trade would be required. Foreign nations would have to get enough dollars not only to pay for goods they bought from us but also to pay interest and dividends on U. S. investments. If our overseas investments increase to $25 billion by 1960, annual interest and dividends owed us will run to almost $1¾ billion.

To pay us that much, foreign nations would have to sell much more in the U. S. than ever before. The 20th Century Fund calculates that imports of $7.3 billion in 1950 and $8.1 billion in 1960 would provide other countries with the dollars they need. Imports ran to $2.5 billion in 1940 so we would have to buy 3 times as much abroad to keep expanding our foreign investments.

With good business, U. S. demand for imported goods should be well above prewar. Rising living standards will widen the market for such consumer items as British tweeds and French perfumes. Moreover, we will need to import more raw materials than ever before because we used up our natural resources at a prodigious pace during the war.

NEW INDUSTRIES

The new methods, materials, and products developed during the war may well have a more profound and lasting effect on future capital requirements than the backed-up demands accumulated in wartime. Here are some of the wartime developments which may have important peacetime applications: new chemical processes and products including synthetic rubber, plastics, synthetic fibers and fabrics; new food products and new methods of food processing; new uses for glass, plywood, and the light metals; tremendous advances in aviation; and new applications of atomic energy and fissionable products in power production and medicine.

Large capital expenditures will be required to push these developments further and adapt them to civilian use. New businesses and perhaps entire new industries will grow up, adding to the demand for capital goods for many years.

THE COST OF GOVERNMENT

To the traditional certainty of death and taxes can be added the certainty that the cost of government will take a much larger share of national income than ever before in peacetime. After the Civil War and again after World War I, federal expenditures moved up to a level four times prewar. And it is already clear that World War II is going to have about the same effect.

In 1940, federal, state, and local governments spent $19 billion, of which a total of $2.2 billion went for national defense, veterans, and interest on the war debt. By 1950, the 20th Century Fund estimates that all governmental units in the U. S. will be spending more than $45 billion. Federal expenditures are estimated at $27.6 billion in that year as against $9 billion in 1940.

Part of the increase is explained by higher postwar prices. Adjusting for price changes would reduce the 1950 figure from $45 billion to $33.5 billion. This is still 80% above the 1940 level. Increased expenditures for public works, social insurance, and schools explain another small part of the rise.

But costs arising out of the war are by far the most important factor. Military and veterans' expenditures and interest on the war-swollen national debt will add up to over $17 billion in 1950. This is only 10% less than total government expenditures in 1940.

The only major category of government expense which would be lower in 1950 is welfare. With high-level employment and more social insurance, relief and other welfare costs should run to $2.5 billion in 1950 as against $3 billion in 1941.

The following paragraphs describe important trends in the major items of government expense.

MILITARY

The 20th Century Fund assumes that we will maintain an armed strength of 2 million men (including trainees) and that it will cost $3,300 to equip and maintain each man, so total military expenditures will run to $6.6 billion. But even if we decide to maintain a smaller armed strength, the total cost might easily be at least $6.6 billion because the present per serviceman cost of over $6,000 a year may not decline.

AND GOVERNMENT ...

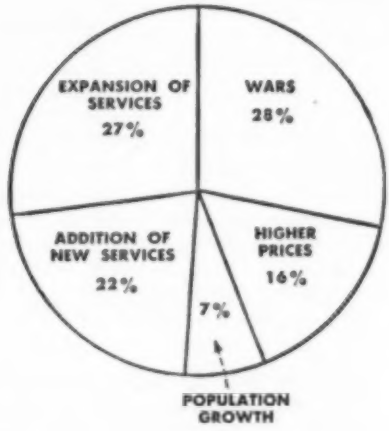
VETERANS

It will cost at least $2.9 billion to take care of veterans in 1950 even if benefits are not increased. That's 5 times the 1941 cost. Pensions for World War I veterans rose steadily from $116 million in 1924 to over $300 million in 1945. That rise will continue for another 20 years. By far the largest expense will be for World War II pensions which are already costing $900 million. Disability and death benefits will cost about $1¾ billion in 1950; hospitalization will add another $250 million; and insurance $150 million.

SOCIAL SECURITY

Future expenditures for social security will depend on whether steps are taken to extend coverage and liberalize benefits. Over 60 million people are now covered so the cost is certain to increase rapidly as more of them begin to draw payments. With high-level employment in 1950, estimated old age and unemployment benefits under the present system would run to over $5 billion. Expansion of benefits, as recommended by the Social Security Board, would raise the cost to over $9 billion.

WHY THE COST OF GOVERNMENT HAS INCREASED. The $25.6 billion increase in cost from 1913 to 1941 was due to:



PUBLIC WORKS

Even an economy-minded Congress is almost certain to go along with expenditures for highways, airports, waterways, flood control and conservation. Thus an increase in expenditures for transportation and natural resources from less than $2.5 billion to over $3 billion in 1950 seems probable.

SCHOOLS

Education ranks third among all government expenditures. In 1941 we spent almost $2.5 billion—10% of all government dollars—on schools. Teachers' salaries account for almost three-quarters of the total cost so the trend towards higher salaries will boost the nation's bill for education.

WHERE TAX DOLLARS GO

(Figures in Billions of Dollars)

	1913	1932	1941	1950 (1944 Prices)	1960
All Government Expenditures	2.5	12.4	23.1	45.5	50.7
Federal	0.7	4.3	12.9	27.6	28.6
State	0.2	1.8	3.6	7.0	9.3
Local	1.6	6.3	6.6	10.9	12.8
Military	0.27	0.7	6.1	5.6	6.6
Veterans	0.18	0.8	0.6	2.9	3.2
Interest	0.15	1.3	1.7	7.9	8.1
Social Insurance	—	0.2	1.9	7.7	8.7
Welfare & Health	0.31	1.5	4.1	4.0	4.1
Education	0.65	2.5	2.7	3.7	4.3
Public Works	a.	a.	a.	5.6	7.1
Transportation	0.40	1.9	2.0	1.8	2.7
Natural Resources	0.03	0.6	1.4	1.2	1.1
Police & Fire	0.19	0.7	0.7	1.0	1.1
Other	0.40	2.4	2.0	3.0	3.6

a. Included in other groups.

NATURAL RESOURCES

The war left the U. S. with a depleted supply of most natural resources, and with critical shortages of some of the most essential minerals. Nevertheless, lack of natural resources should not be a limiting factor on our productive capacity. With relatively free access to world markets, we should be able to get all the raw materials we need. And, even if we were denied access to world markets, we could use our low-grade reserves and develop substitutes without causing a prohibitive reduction in our living standards, though everyone would feel the effects in one way or another.

The U. S. economy consumes about a billion and a half tons of raw materials each year, or about 11.5 tons per person. Of this 3.5 tons are coal, 1.5 tons are petroleum, and iron and copper ore each contribute about a half a ton. In 1939 the value of unrefined minerals output was $4.2 billion and 2% of all workers were engaged in mining or lumbering.

FUTURE REQUIREMENTS

The level of industrial production projected by the 20th Century Fund would raise minerals requirements a third above 1940 by the year 1950 and 50% above 1940 a decade later. Here is how natural resources requirements in the 1950 decade would compare with 1940 and the wartime peak: (Index numbers, 1940 equals 100)

	Wartime Peak	*1950*	*1960*
All minerals	138	133	151
Metals	157	117	126
Fuels	130	141	164
Other	141	128	142
Lumber	126	93	76
Electric Power	159	173	224
Manufactured Gas	120	94	75

The capacity of our supplies of natural resources to support future levels of output cannot be determined with any great accuracy. It will depend on the size of our reserves and on our ability to use supplies more economically and develop substitutes.

WITH THE RESOURCES AVAILABLE . . .

Because there is no way to measure these factors with any degree of precision, all estimates of the number of year's supply are subject to wide errors. However, such estimates are useful in directing attention at those resources where every effort should be exerted to develop new supplies, substitutes, and more economical methods of use.

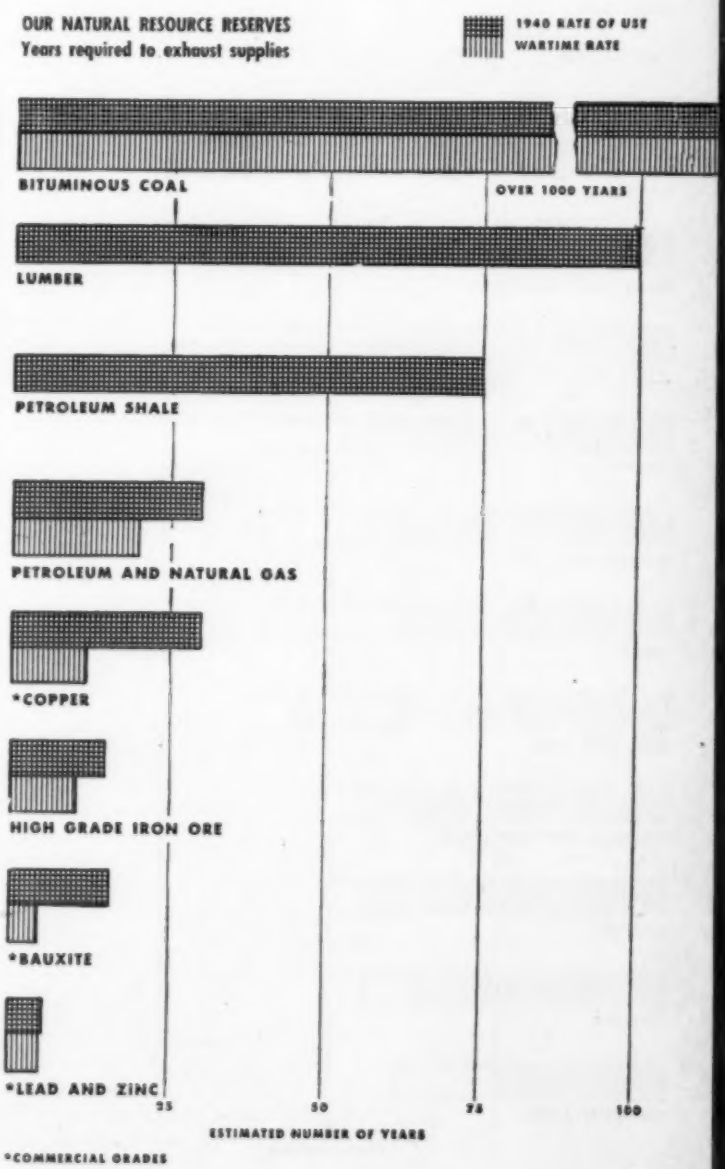
BIGGEST PROBLEMS: LEAD AND ZINC

Commercial grades of zinc, lead, and bauxite will be exhausted before 1960 even if the rate of use is cut to half the wartime rate. Supplies of petroleum and natural gas—which furnish 40% of our energy—will last longer than 20 years but their partial depletion will raise many technical and economic problems long before that time. Possible exhaustion of high-grade deposits of such minerals as iron and copper in the foreseeable future will stimulate development of processes to use low-grade deposits.

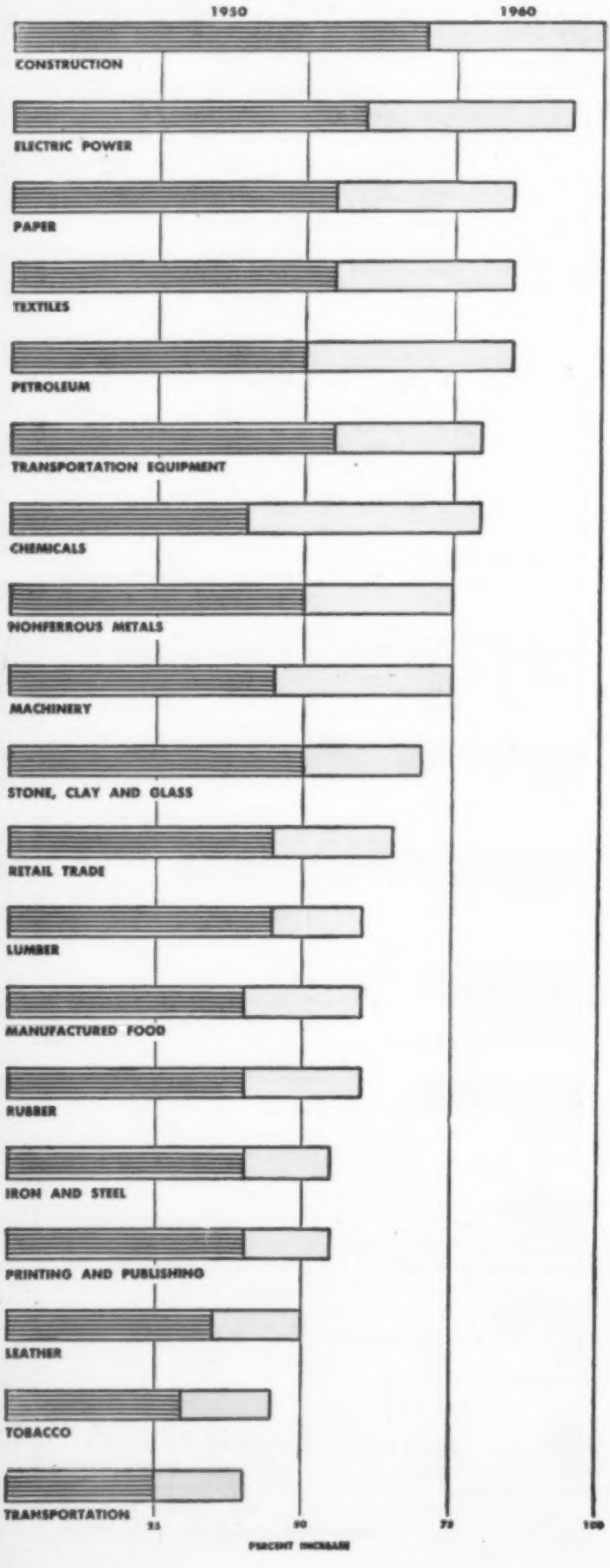
We have been discovering more and more ways to stretch our supplies of natural resources, however. In the case of tin, the electroplating process saves 50% of the tin used in tinplate production. The electric power industry uses less than 40% as much coal per kwh now as in 1920. The development of new materials and new ways of using old materials also expands our resource capacity.

Our bituminous coal reserves are adequate for over a thousand years even at the wartime rate of use, though production costs might rise substantially as inferior coal beds were used. After that, there are huge deposits of sub-bituminous coal and lignite which could carry us along for another thousand years. In comparison, maximum petroleum reserves are minute, adequate only for about 30 years consumption at the current rate. That is why the experts are trying to find ways to produce oil from coal cheaply enough to be commercially feasible.

Even though we have been using up lumber faster than it grows, there is little doubt that enough will be available in the future to meet at least minimum needs. Annual timber growth runs to about 32 billion board feet. But we cut over 40 billion board feet a year before the war and lost another 6 billion through fire, insects, and disease. An adequate conservation program could increase annual growth enough to offset this depletion.



PRODUCTION PROSPECTS: Estimated Percentage Increase in Industrial Activity Over 1940



INDUSTRIAL CAPACITY

At the end of World War II U. S. industry found itself with surplus capacity in some lines and serious deficiencies in others. There was more than enough aircraft, machine tool, and synthetic rubber capacity but not nearly enough sheet steel, copper, or electrical machinery capacity to meet pent-up demands.

War experience showed, however, that industrial capacity can be expanded enormously in a few years, given the need and the funds. Thus lack of industrial capacity should not prove a bottleneck to meeting the demands of consumers in the 1950 decade.

A rough estimate places our total investment in industrial facilities (manufacturing, mining, transportation, and distribution) at $200 billion. Just how much capacity industry as a whole, or any given industry, has is impossible to measure.

Capacity is a most elusive concept. In a technical sense, the capacity of an industry is the combined production of all its plants working 24 hours a day, 365 days a year, less an allowance for repairs, breakdowns, and other technical factors. Actual capacity is far less, however. Some facilities are obsolete or high-cost. Supplies of raw materials and components may be insufficient to keep assembly plants running full-steam. Moreover, demand for many products isn't great enough to support round-the-clock production.

PLENTY OF CAPACITY

During the past quarter century, however, experience shows that we have had more than enough overall capacity, and more than enough capacity in almost every industry, to meet all demands. An extensive study showed that even in 1929 only the steel and machine tool industries were definitely operating at capacity.

The growth of productivity as old machines are replaced with new and more efficient ones and as new techniques are developed is one of the main reasons why industrial capacity more than keeps pace with markets. The depression of the 1930's led to a net retirement of about 5% of total manufacturing facilities but manufacturing plants in 1939 could have turned out a quarter more than in 1929 because productivity was a third higher.

Whenever an industry's output begins to approach technical capacity, it becomes profitable to purchase new and more efficient equipment to replace or supplement existing machines so that a certain amount of excess capacity seems to be inevitable in a free enterprise system.

Estimates of the level of industrial production in different lines under conditions of high-level employment during the 1950 decade are shown in the chart. They assume that past trends will continue so that they give only a rough idea of what would happen to output in each industry. Unpredictable shifts of consumer demand or new product developments might cause a big change in the pattern of industrial production. Such estimates are, nevertheless, useful in that they provide a clue to lines where the largest increases may take place.

None of the projected increases are so large as to tax our ability to provide enough capacity. This is not to say that there will be no bottlenecks because of lack of capacity for certain components, for instance. However, we should be able to make good in short order any deficiencies of that sort that may develop.

DEMANDS VERSUS NEEDS

Despite the substantial increase in living standards which would be possible with high-level production and employment in the 1950 decade, many U. S. consumers will be unable to buy enough of life's necessities to maintain themselves at a health and decency level. Almost 30% of all families would receive less than $1,000 a year cash income and one-third of this group would receive less than $500.

The 20th Century Fund asked a series of experts to estimate the quantities of food, clothing, housing, medical care, and other things needed to provide a standard of living at a minimum health and decency level. The experts also figured out how much it would cost to bring everyone expected to be below that standard in 1950 and 1960 up to the calculated level. In other words, the estimates show the cost of establishing a "floor" for consumption without disturbing the spending patterns of those who received more than enough income to satisfy the calculated minimum needs.

ESTIMATES OF NEEDS

Any estimate of "needs" must rest upon someone's opinion as to what constitutes "health and decency" in this day and age. In the case of food, the nutritional requirements of a minimum health and decency standard can be determined accurately. In other fields, such as housing and education, even the experts would disagree over what constitutes a minimum standard.

However, what is important is not the precise size of the estimates but their general magnitudes. The conclusion that we would have to spend about 50% more on medical care than we are likely to in 1950 is important even if the experts' appraisals of the deficit range from as high as 60% to as low as 40%.

To fill total needs calculated in this manner would require production of $200 billion of goods and services in 1950 or 13% more than the $177 billion which would be turned out with high-level production and employment. In 1960, estimated production would fall short of needs by 8%. Food accounts for the biggest share of the deficit but needs outrun demand by important margins in housing, medical care, education, and social security.

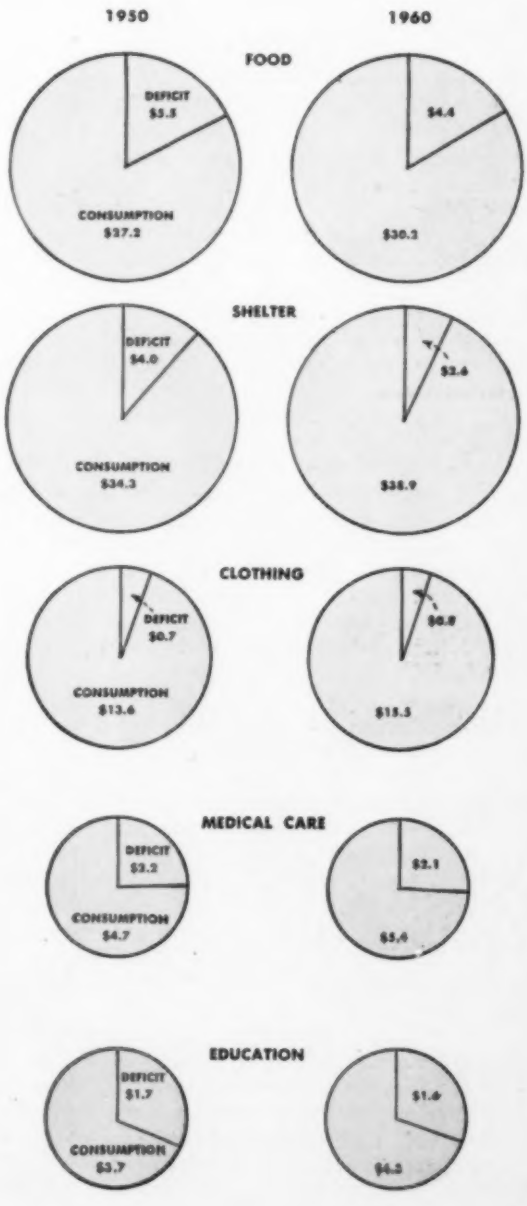
TO MEET ALMOST ALL OUR NEEDS

To provide nutritionally adequate moderate-cost meals for those unable to afford them would add $5.5 billion to the $27.2 billion that would actually be spent on food in 1950. This assumes no change in diets of those with adequate incomes despite the fact that many people in those groups do not eat what they should. If we all ate what we needed, we would consume twice as many fresh vegetables as in 1940, half again as much milk, more fruits and tomatoes; and we would eat smaller quantities of sugar, sirups, fats, and oils. This better diet would cost us less than we will actually spend for food in 1950.

So large a portion of our existing housing is unsatisfactory by any reasonable standards that it would take 10-15 years to provide everyone with adequate housing. One of the reasons why we don't have adequate housing is that many consumers cannot afford to pay enough rent to finance it. Estimated expenditures in 1950 for rent (including the estimated rental value of owner-occupied homes) would run to $14 billion as against an estimated need of $16.4 billion.

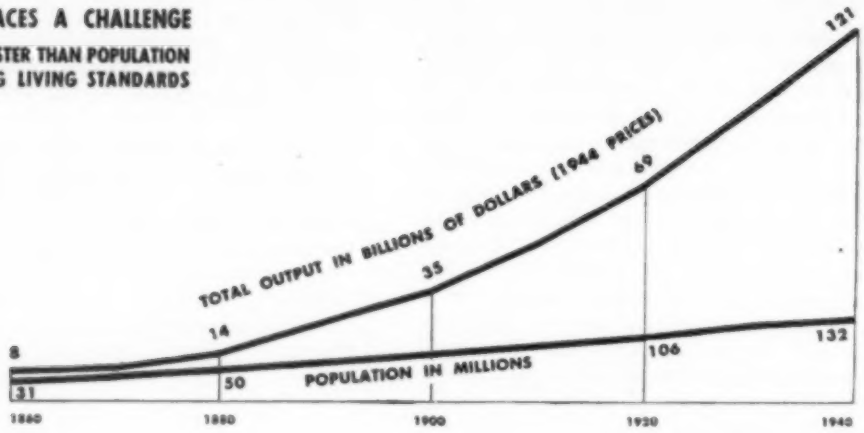
Vast advances in medicine have gone far toward eliminating many diseases and have brought about a steady improvement in the standard of health. However, large numbers of people in the lower income groups cannot afford adequate medical care. Moreover, to supply good medical care for everyone under the traditional fee-for-service basis would cost several times more than consumers have ever spent for medical services even in prosperous years. Development of an effective form of group medicine, however, would make it possible to provide adequate care at a great saving over present costs, according to the 20th Century Fund.

HOW CONSUMPTION WOULD COMPARE WITH TOTAL NEEDS
(Figures in billions of dollars)



THE U. S. ECONOMY FACES A CHALLENGE

PRODUCTION HAS GROWN FASTER THAN POPULATION GIVING PROMISE OF RISING LIVING STANDARDS



The major conclusion of the 20th Century Fund's survey of America's needs and resources is that we have reached a point where we can provide everyone with a decent living and most people with a living which, by any standards other than our own, is positively luxurious. With high-level employment, it would take only a 13% increase in total output in 1950, and an 8% increase in 1960, to lift everyone to a minimum health and decency standard of living.

We have more than enough industrial and agricultural capacity to support that much of an increase in total production. Lack of natural resources should not be a bottleneck, for with world trade on any sort of a reasonable basis we will be able to get all the raw materials we need.

The only limiting factor is the capacity of our labor force to produce. The 20th Century Fund assumes that productivity will advance at the average rate actually achieved during the past 9 decades (18%). But there is no technical reason why we cannot achieve an increase of more than 30%. That would make possible enough production to meet our minimum needs.

The U. S. economy has exhibited two dominant characteristics in the past century. Our productive capacity has expanded at a rate never approached elsewhere. But our economy has also been highly unstable. Our problem is to make the most of our unparalleled technological and productive know-how while minimizing the swings of the business cycle.

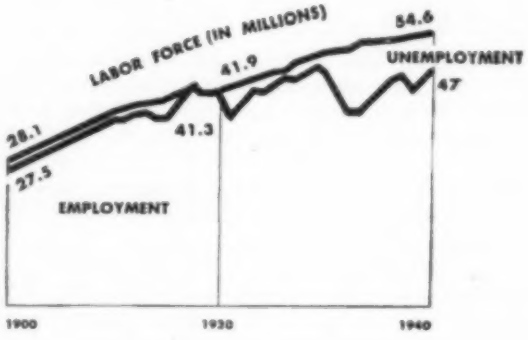
If we can meet that challenge, we can eliminate the specter of want and move on toward constantly rising living standards for everyone. Never before in history has a nation been so close to abolishing poverty and meeting the material demands of its citizens.

This is not to say that solving the problem of maintaining stable and expanding production would solve all our economic, social, and political problems. Nor is it to say that a solution of the problem of keeping our economic machine running on an even keel is at hand.

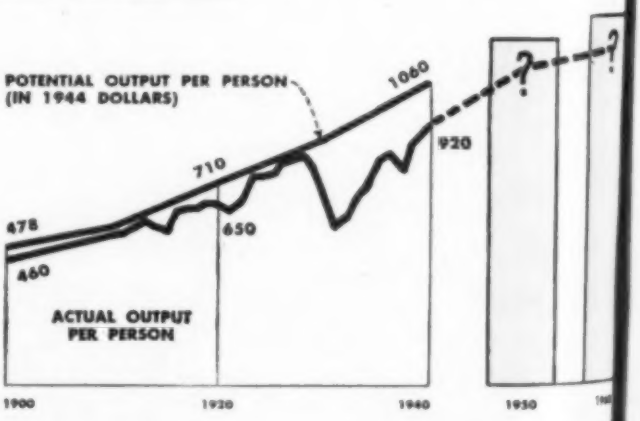
In the first place, the U. S. would not be a utopia even if we achieved the kind of high employment and production the 20th Century Fund is talking about. Many perplexing problems of how to best distribute our production would remain. Then there are a host of social and political problems which would still tax our efforts and ingenuity. Finally, there is the all-important question of how to maintain world peace.

Most people would agree that the problem of maintaining high employment and rising living standards is still far from solution. Our ability to mobilize and direct our economic resources so as to keep our economy running on an even keel has lagged behind our ability to solve technical production problems. Each businessman, each worker, and each consumer must somehow learn to act differently in many ways than he has in the past if we are to solve our number one economic problem.

BUT THE GROWTH HAS FOLLOWED THE BOOM AND BUST ROUTE INVOLVING LONG PERIODS OF MASS UNEMPLOYMENT



CAN THE ECONOMY PROVIDE STEADY EMPLOYMENT AND RISING LIVING STANDARDS?



Just what changes in our economic life will be necessary no one knows. On our ability to find out these things and put them into practice in the next few years depends our success in meeting the challenge which the 20th Century Fund's study underlines. That challenge is that we have within our grasp the ability to eliminate actual want from the U. S. and to provide more and more things for better living for everyone.

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ACTIVATED ALUMINAS	Al_2O_3 In granular form, highly porous and highly inert. Current uses: Desiccants and dehydrants, catalysts and catalyst carriers, maintenance of transformer and lubricating oils, and chromatography.
CALCINED ALUMINAS	Al_2O_3 Calcined to various degrees resulting in a wide variety of characteristics. Current uses: Abrasives, ceramics, glass, porcelains, refractories, electrical insulators, ferrous-metal fluxes.
LOW SODA ALUMINAS	Al_2O_3 (With less than 0.15% Na_2O). Two grades provide low and normal shrinkage characteristics. Current uses: High-grade electrical insulators and other ceramic bodies.
TABULAR ALUMINAS	Al_2O_3 (Alpha Alumina). Available as fine powder, coarse granules and dense balls. Residual moisture: 0%. Soda content as low as 0.05%. Extremely low shrinkage. Current uses: High quality electrical insulators, high temperature refractories, catalysts and catalyst supports, and heat-transfer operations.
HYDRATED ALUMINAS	$Al_2O_3 \cdot 3H_2O$ (Typical compound). Fine white crystalline powders, more reactive than calcined aluminas. Current uses: *Series C-30 grades*—chemicals, catalysts, ceramics, glass and water softeners. *Series C-700 grades* (average particle size: 0.5 micron)—rubber and plastic compounding, cosmetics, pigments and fillers.
ALUMINUM FLUORIDE	AlF_3 (Anhydrous). White crystalline solid, chemically inactive at room temperature. Current uses: Non-ferrous metal fluxing and constituent of ceramic-body and glaze mixes.
SODIUM FLUORIDE	NaF A fine, white crystalline powder, light and fluffy with good dusting properties. Current uses: Ingredient of insect powders and rat poisons, constituent of vitreous enamel and glass mixes, and a steel de-gassing agent.
SODIUM ACID FLUORIDE	$NaF \cdot HF$ A free-flowing, white crystalline powder. Does not cake under normal storage conditions. Readily soluble in hot or cold water. Current use: Laundry sour for rust removal and for neutralizing last traces of alkali in rinsing operations.
FLUOBORIC ACID	HBF_3 E. B. concentrate—a specially purified solution of fluoboric acid. Principal current use: Electrolytic Brightening of aluminum. (Patented process.)
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WATCHING WASHINGTON

R. S. McBride, EDITORIAL CONSULTANT
Donald O. Loomis, WASHINGTON CORRESPONDENT

Regulations may be forthcoming to supervise transportation of nitrate of ammonia . . . "Buy American" policy followed in acquiring stockpiles of raw materials draws criticism . . . Courts more liberal than Internal Revenue in allowing accelerated depreciation due to intensive war use of equipment . . . Revised rules for leasing public potash lands . . . German chlorine cells turn up at Edgewood Arsenal . . . Weather Bureau has setup to give aid on industrial problems . . . Government geologists report an alarming shortage of water in several areas . . . Urea-formaldehyde fertilizer developed

Nitrate Shipments

THE COMPLICATED series of conditions which led to the explosions of two ships loaded with ammonium nitrate and the destruction of Texas City, Tex., will ultimately lead to new regulations on the shipment of the chemical. The new regulations, which surely will result from the many inquiries into cause of the explosion, would establish ammonium nitrate under an "explosive" classification. Under Coast Guard and Corps of Engineers regulations, explosives in ships are given special handling and come under special safety precautions. The nitrates, not now listed as explosives, are subject only to fire safety precautions.

Two bad effects on business may result because of "scare" information on the chemical. First, farmers who have been buying ammonium nitrate for fertilizer use may stop using it because of misinformation. Second, the fertilizer industry which has been buying surplus nitrate plants from War Assets Administration may get stuck with a "white elephant" and no market for the product.

Industrial Effect

INDUSTRIAL and also governmental changes in several divisions of process industry have been or will be scheduled as a consequence of the Texas City disaster. Synthetic rubber production will need some rescheduling to offset the loss of styrene supply from Monsanto's Texas City destroyed plant. Although only a small part of the Monsanto plant's 72,000 ton production was going into synthetic rubber, what was used was being shipped to nearby Gulf Coast polystyrene and GR-S plants in barges, obviating use of tank cars which are in very short supply. In channeling styrene supply into other plants, tank cars probably will be needed, further complicating that shortage.

Plastics manufacturers and users will be the hardest hit from the styrene standpoint. The Texas City plant had a capacity of approximately 28 percent of the national production, in addition to polystyrene facilities which were under construction. Early in the year plastics producers saw the polystyrene supply coming into balance with demand, but now see their dreams blown to bits with the loss of approximately one-quarter of the total supply.

Will Quality Suffer?

STOCK pile building has been handicapped by certain "Buy American" requirements in the law under which these strategic materials are gathered for purposes of national security. Those who advocated this statute are pointing out in official circles two dangers of overemphasis on this requirement that gives advantage to American producers' goods which might go into the stock pile.

Newly emphasized is the fear that by purchasing of American strategic materials the Treasury Department may be taking a grade of mineral which is less than that really needed for military usage. As a consequence some mineral advisers are urging that the purchase specifications for ores and metals be maintained at the highest practical level, even though this slightly delays securing of some commodities.

The second criticism of the "Buy American" plan is that resulting from price advantage granted to domestic suppliers under some circumstances. When their goods are so favored, the cost is inevitably higher and the quantity of strategic available for each million dollars spent is inevitably less.

Partly on the basis of these objections the White House has made it known definitely that it does not wish the "Buy American" feature of the act to be utilized for either extravagant payments or depreciation of the quality of goods put into the stock pile. In fact unofficially it is known that many of the government executives would like to have no domestic goods purchased for stock pile purposes so that all of the dollars used would go abroad for the stabilization of trade and the relief of emergency conditions in the countries supplying strategics. This last argument goes back to the known fact that the money does not go abroad. The government merely takes the imported strategic material in pay for some of the foods and essentials which we have shipped abroad either on a free or credit basis.

Depreciation Claims

SEVERAL recent informal opinions by the U. S. Tax Court on claims for accelerated depreciation due to intensive war use of plant and equipment indicate that the court is taking a more liberal view of the idea than is the Bureau of Internal Revenue. Surprisingly the court so far has not had to give any formal opinions on the matter, probably because of the lack of enough cases of this type to make a formal opinion necessary.

Memoranda and briefs on the Locke Machine Co. case show the Commissioner of Internal Revenue holding the company's statements on increased activity, taken alone, were not conclusive on the amount of depreciation suffered. The court, however, allowed the company 9 percent for 1941 as against 7 percent approved for four previous years by the commissioner,

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who would have preferred a 5 percent allowance. Similarly, in the case of N. A. Woodworth Co. vs. Commissioner, the court allowed a 12 percent depreciation for 1941 over commissioner's protest.

It is safe to conclude from these and other recent cases, although the court does not wish too much reliance placed on its informal opinions, that (1) the court recognizes the validity of allowing abnormal depreciation due to intensive use of facilities; (2) will accept overall data showing increased activity as evidence of such use; (3) gives credence to informed testimony on plant conditions; and (4) may allow accelerated depreciation on all productive facilities in a plant.

So far the Commissioner of Internal Revenue, more cautious than the court, has denied all claims for accelerated depreciation on a plantwide basis. In some instances, the commissioner has allowed larger depreciation on certain machines where the taxpayer has proved conclusively that their useful life was shortened by intensified use. The commissioner has held that any modification of normal depreciation will be confined to those items where useful life depends on wear and tear, and, that since accelerated use nearly always depends upon increased maintenance, accelerated depreciation is allowable only to the extent that maintenance fails to arrest depreciation.

New CPA Requirements

PREVIOUS CPA allocations requirements which have been continued under a new regulation include those covering certifications on purchase orders and documents, use of materials acquired with allocation assistance, inventory restrictions, records, audits and inspections, and violations. The continued "housekeeping" requirements will apply to CPA controls over cinchona bark and cinchona alkaloids; streptomycin; natural and synthetic rubbers; cordage fibers and products; antimony; tin and tin products; and materials for export to meet specified needs. Congress authorized continuance of these controls March 31.

In the future, issuance of authorizations to place certified orders will be limited to expediting purchase in this country of minimum quantities of scarce materials required to expand foreign sources of supplies badly needed in the United States, and to cases where the assistance is required to meet international commitments. Applications for CPA export preference certificates, for all destinations except Canada, will be addressed to the Office of International Trade, Department of Commerce. Certificates to cover Canadian deliveries will go directly to CPA.

Chemical Shortages

SUPPLY of industrial chemicals continues in general to be insufficient to meet consumption requirements, although January production figures point encouragingly to attainment of higher output, according to the April Industry Report on Chemicals and Drugs released by the Department of Commerce. However, distribution of many chemical products, complicated by boxcar, tankcar and container shortages, will be tied up even more in coming months. Tank cars are all in active use and new production is very slow. Boxcar production, now at 2,000 to 3,000 a month, may jump to 10,000 a month by July if steel production continues at a high rate. Offsetting this car increase, however, will be a heavy increase in car demand due to wheat and other crops coming back on the agenda. Container production, hinging on steel strip and an adequate supply of tin, is not expected to balance with demand until late in 1947 or early 1948.

Production progress on specific items, as outlined in the Commerce report, follows: Sulphuric acid production is meeting practically all needs. Alkali output reached a high in January. Chlorine production rose and compressed gases showed increases. Ammonia and nitric acid registered peak outputs. Chromium chemicals are still below demand. Phosphoric acid production declined in January. Calcium phosphates are being supplied at greater rates than in previous years but supplies of sodium phosphates are far below requirements. Salt cake is in short supply. Supplies of coal-tar derived chemicals have shown improvement under high, steady output but shortages continue for a number of them. Consumers of maphthalene, creosote oil and tar acids have had trouble covering their requirements but benzene has been in sufficient supply to take care of all consuming needs.

New Potash Rules

REGULATIONS for exploration permits and leases to develop potash on public lands have been revised in three major ways. The new regulations were issued early in April and are now determining the basis on which permits will be granted to industrial groups, agricultural co-ops, and individuals.

Perhaps most significant of the new rules is a definition of qualified applicants which now makes it considerably easier to qualify for an exploration permit. Permits may now be issued to a single individual or company for as much as 25,600 acres, a much larger acreage than was previously permitted for a single applicant. And this acreage is in addition to the area being operated under lease, which is limited to 15,360 acres. Thus, a single applicant may now have an interest in a total area of over 40,000 acres.

Under the old regulations a lessee producing potash had to recognize a demand on the part of the government for as much as 25 percent of his production. Under the new rules the set-aside is limited to 10 percent. Thus, the opportunity for the government to get into business by taking some commercial output is restricted.

Certified as "Necessary"

IN ORDER to be held for allocation under the present law, any class of goods must be certified as necessary to meet international commitments of the United States by joint action of the Secretary of State and Secretary of Commerce. During April the first such certification listed principally food raw materials and foods required for export under emergency relief programs. Also certified were a few products of chemical process industry, including: ammonium nitrate, soap and soap powder, fatty acids, oil cake and oil cake meal, and certain fats and oils and oil bearing seeds.

Lost Cells Found

A SPECIAL committee from the American Chlorine Industry investigated German practice about a year ago. To supplement their excellent report they selected certain typical mercury cell equipment to be brought to the United States for demonstration and further experimental use. The equipment was crated and prepared for shipment to the United States. Then it disappeared. This spring it is discovered that 50 large crates of this material have been at Edgewood Arsenal since last August. The Chemical Corps has been unboxing and setting up this equipment at Edgewood where interested American firms can view it. It is hoped that some experimental trials on the equipment also will be arranged under proper auspices. The industry is pleased at the plans but disappointed that many months were lost because no one took the trouble to find out

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what was in these 50 cases of material from Germany some of them weighing nearly five tons.

Coal Gases Interest FPC

UNDERGROUND gasification of coal, although it received no attention during the recently closed Federal Power Commission hearings on natural gas, is now in the Commission's eye. FPC staff engineers have been preparing a survey of the subject for the commissioners, who want to know about the economics and technical aspects of manufacturing fuel gases. The staff work covers not only underground coal gasification but other types of gas production processes developed in this country and abroad.

Staff engineers are burrowing through the testimony accumulated during the natural gas hearings in order to summarize it and present it, along with recommendations, to the Commission. Toward the end of March, five summary reports had been prepared: "Natural Gas Reserves of the U. S."; "Procedures and Problems in Producing, Gathering and Processing Natural Gas"; "State Conservation Laws"; "Section 1-B of the Natural Gas Act With Reference to Production and Gathering of Natural Gas"; and "Administration of the Certificate Provisions of Section 7 of the Natural Gas Act." On the way were other reports dealing with use of natural gas, long distance transmission and manufacture of synthetics.

Industry and Weather

SINCE its recent organization, the Industrial Climatology Section of the Weather Bureau is facing an increasing volume of requests for assistance on industrial problems, a number of these inquiries coming from the chemical industry. The I.C. Section is developing the application of analytical treatment of weather information conceived during the last war to industrial and commercial uses.

Section officials are troubled by a general impression that the service being offered consists either of mailing packages of historic weather data or making long-range weather forecasts. They declare that neither procedure is involved. Essentially, this sector of the Weather Bureau is in the business of getting a grasp of weather-affected problems submitted to it and then working out answers based on its own studies of the weather factors involved. The answers are in terms of probabilities, not certainties.

Officials consider that practically all problems affected by climatic conditions are susceptible of treatment. Examples are: location of manufacturing plants, seasonal changes in fuel or cooling requirements, packaging, care of materials in transit, location of warehouses and selection of protective coatings, roofing materials and lubricants.

Consultation Important

INDUSTRIAL climatologists in the Weather Bureau emphasize the importance of close consultations with representatives of industry and commerce. Until the Bureau understands the specific problems involved, no start can be made toward their solution.

The service offered is at cost. An estimate of the cost of a study will be made by consultation between the client and the Industrial Climatology Section. The general policy is that the client will deposit the sum involved with the Treasury Department, any excess later being returned. So far, the record shows that time needed for investigations ranges from a few hours to a year or more.

Too Little Water

GOVERNMENT geologists have reported for a considerable number of areas in the United States a definite decline in both surface-water and ground-water supply. This is approaching alarming proportions in some territory, they say. Shortage takes various forms in different neighborhoods. Sometimes it is a quantity decline of surface runoff, elsewhere a lowering of the water table in the ground, frequently pollution reduces usable quantities, and in recent years upstream users sometimes raise the temperature of a whole river to a point that cooling water at suitable temperature can no longer be taken from it.

Price Cutback Sought

FOR SEVERAL months Washington has been worrying about the price spiral. Economic advisers of the President and Congress seem to have been almost unanimous in their private reports of threatened economic dangers unless immediate cut-back in retail prices can be achieved. Fortunately for the program, this has not become a partisan issue.

Spokesmen for process industry are pointing out that industrial goods' prices from our chemical industries have advanced relatively little in most cases. Data from Bureau of Labor Statistics are particularly helpful in showing this fact. Application of these data is being made along the following lines: Most of the factors in wholesale price which contribute to the cost of living are now between 125 and 140 on the index number basis of 1926 equals 100. Within that range are textiles, metals, chemicals and allied products, and house furnishings. A few miscellaneous items and fuels are even lower. In sharp contrast are the figures for food at 166, leather at 174, and farm products at 183. The only other high index number is for building materials, 177, and lumber is a very large factor in that high figure.

These facts from an impartial official source are interpreted as proof that agricultural prices are the principal present cause of high cost of living. The diagnosis seems generally accepted. Treatment of the economic ill is still subject to bitter controversy.

Effluent Disposal

WASHINGTON has been publicizing lately some methods used by German chemical industry for disposal of industrial waste. A major method used there, as in this country, is the disposal of effluent into large volumes of water providing quick dilution to unobjectionable levels. One reported technique, apparently novel for the United States, is the discharge slowly and uniformly into a stream by a pipe opening near the bottom of the river where regular water flow promotes quick dilution. Thus the engineer takes full advantage of natural mixing tendencies even at low water periods.

Container Supplies Low

SHORTAGE of containers as well as of transportation facilities will continue to hamper the operations of many chemical manufacturers in the months ahead. Paper, steel and wood for containers are in short supply although the end is in sight for steel. New rolling mill capacity (about 400,000 tons per year) will go into production in the fall and next year steel will not be a problem in the supply of cans or drums assuming there are no major strikes affecting production. Even so, manufacturers using tin cans may expect no better supply until shipments of pig tin and tin concentrates are received in quantity from Malaya and the Dutch East Indies. The shortage of tin will limit production of tin plate and replace the present shortage of steel. Ironically, tin which must be imported and which gave no

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CHEMICAL COMMENTS

Dichloro (Phenyl Ether) Stops Attacks of Ambrosia Beetle in Green Lumber

Chemical control of Ambrosia (pinhole) Beetles is offered by Dichloro (Phenyl Ether). Attacks by the beetles, which bore into green timber and freshly sawed lumber of many hardwoods, are stopped by the chemical, and prolonged protection is given. An oil solution or a water emulsion may be applied to the freshly cut lumber with any type of hand or mechanically operated pressure sprayer. Since Dichloro (Phenyl Ether) mixes readily with inexpensive light oils of the kerosene range, and presents no handling difficulties, treating solutions are easily prepared locally.

Improved Ink Gloss Follows Sizing of Paper Surface with Methocel

Penetration of printing ink is minimized by a light coating of Methocel, and the gloss and brightness of inks or varnishes subsequently applied is noticeably improved. Applied as a surface sizing at the water boxes of the calender stack, Methocel deposits a film possessing a high degree of adherence to paper or paperboard. And, on waxing stock, a light prime coat of Methocel greatly reduces the penetration of paraffin, and maintains the opacity and whiteness of the original stock.

Coating Fabrics for Chemical Resistance

Saran F-122 Latex, a new Dow material for the textile industry, is used as a coating, impregnating and laminating agent in the treatment of fabrics. Coated with Saran Latex, fabrics are particularly well-suited for industrial use where chemical and abrasion resistance and durability are important. They are made resistant to water, oils, greases, gasoline, and acids in the making of protective clothing, tarpaulins and other products. Yarn and thread can also be coated with Saran Latex, making them waterproof and resistant to picking and linting.

50th Anniversary 1897-1947

DOW

CHEMICALS INDISPENSABLE
TO INDUSTRY AND AGRICULTURE

insurmountable supply problems during the war, is becoming acutely critical a year and a half after the end of hostilities.

World production of tin is estimated at 119,000 tons this year. World requirements are about 190,000. As a result, the government stockpile will have been exhausted by the end of the year or before whether government control of tin is extended beyond June 30 or not, according to the latest official estimates. This conclusion was reached without regard to possible damage to the Texas City tin smelter or loss of concentrates in the fire and explosion at the Monsanto plant.

Labor's Chemical Series

DESPITE difficulties in maintaining its personnel, the Division of Labor Standards, Labor Department, is trying to keep alive its pamphlet series "Controlling Chemical Hazards." The sixth (benzene) and seventh (inorganic dusts in air) pamphlets dealing with chemical industrial hazards and means of their avoidance were issued last month. During 1946, only two, one devoted to sulphuric acid and the other concerning aniline, were prepared and published. The series was inaugurated in 1945, when pamphlets on ammonia, formaldehyde and chlorine were issued.

The Division of Labor Standards series is complementary to the Chemical Safety Data Sheets issued from time to time by the Manufacturing Chemists Association. Whereas the information prepared by the Association is designed primarily for use by those in managerial and supervisory positions, the Labor pamphlets are directed to the men farther down the line. The pamphlets draw their information from various sources, but lean heavily on the Manufacturing Chemists Association for data and other forms of assistance. The volume of requests for information on various chemical hazards guides the Labor Department agency in choosing its subjects.

A New Antibiotic

A POTENTIAL new antibiotic apparently can be developed from tomatin which is a component of the cultivated tomato plant as grown commercially in the United States. This chemical is capable of inhibiting the growth of certain soil-borne fungi which cause tomato wilt and other plant diseases. Work on this material is in progress at the Beltsville labs of the Bureau of Agricultural and Industrial Chemistry. Only preliminary scientific results have been released, but the Bureau will welcome further development in the hope that a new pest control chemical can be had for both plant disease and possibly human-disease control.

Urea-Formaldehyde Fertilizer

A NEW nitrogen carrier has been developed experimentally by the Department of Agriculture. This is a combination of urea and formaldehyde which has been christened Uraform by the scientists whose preliminary results indicate unusual advantages where slow-acting nitrogen is needed. The new combination (it is not a true compound) carries normally about 1.25 molecules, or a little more of urea per molecular unit of formaldehyde. Lower nitrogen ratios make the nitrogen less available for the plant. Much higher nitrogen ratios are too costly to be practical.

Field experiments have not yet been made. Early trials on turf and citrus are anticipated. Plastics makers interested in the same raw materials may be worried by this threat of new competitors for scarce raw materials. But it is evident that fertilizer men will not pay as high prices for these plastic-making compounds as the plastic maker can afford to pay.

Pest Survey Urged

AS A PART of the proposed research and marketing program of the Department of Agriculture, it has been urged by Agricultural Insecticide and Fungicide Association that a pest survey be undertaken soon. The purpose is, of course, to assist crop protection by industrial planning based on real knowledge, not guesses. AIFA suggests six pertinent questions: What insects, fungi, weeds and other pests, not now controlled, are causing serious economic losses? What crops are not being adequately protected? What weeds need to be eradicated? What acreage is involved, and where? What are the potential fields for defoliants and soil fumigants? What will protection cost, compared with values of increased yield or improved quality resulting from protection?

Thermal-Shock Test

ENAMELWARE utensils and other enameled products are being tested for the Treasury Department by National Bureau of Standards in an effort to establish a definition of thermal-shock resistance. The test currently used provides the heating of the enamelware to predetermined temperature, then quenching with cold water. The test temperature is raised step-wise until failure occurs. Contemplated specifications thus can be applied with assurance of a definite test to determine compliance.

Minor News Glimpses

Alcohol sales by Reconstruction Finance Corp. this year will total about 15 million gallons. The first offering in April was one and a quarter million gallons of Cuban alcohol sold under sealed bids.

Natural rubber may now be used somewhat more extensively in many types of tires. CPA intends to continue control of this usage probably for the full year in order to secure equitable distribution of still limited supplies.

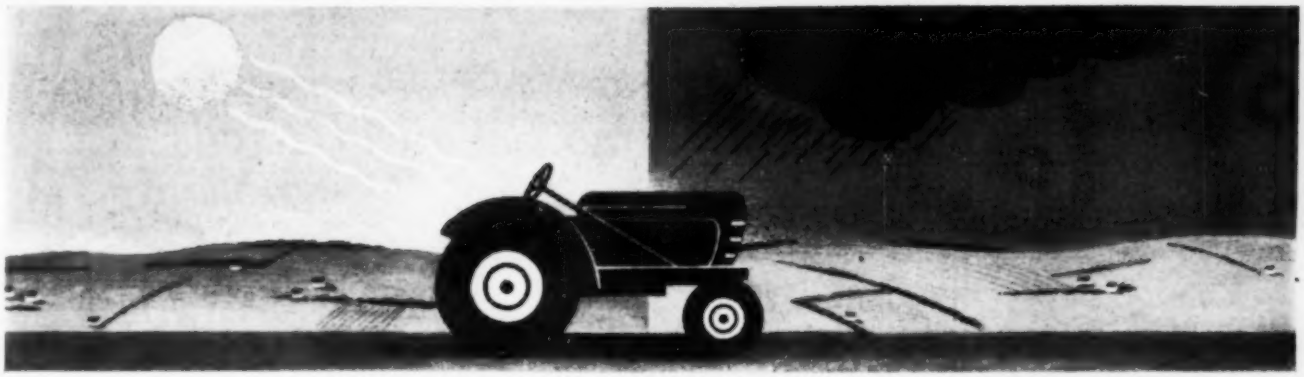
Penicillin production is being encouraged abroad. In one case an American plant was purchased and is being shipped to China with government aid. Other new producing units are reported in Spain and Sweden. Russian output has been expanded. All this has official support from Washington.

Pipeline and pumping station removal for resale is contemplated by Keystone Pipe Line Co. of Philadelphia which recently bought the 180-mile Plantation Pipe Line which was built for petroleum products movement during the war. Present conditions make tanker and tank car movement of oil and products more economic than handling through this particular line.

Fissionable material is defined by Atomic Energy Commission as including all substances containing by weight as much as one-twentieth of one percent of uranium, thorium, or the two together.

Debt claims against alien enemy property seized prior to Jan. 1, 1947, must be filed not later than June 1 with the Office of Alien Property in the Department of Justice. OAP, which furnishes forms says claims totaling about $120 million already have been received.

Talc discoveries in Nevada have been made at the Reed talc mine in Esmeralda County. A special report is available at U. S. Geological Survey offices in Washington and at Reno, Nev. The material has, however, not been printed for distribution.



for enamels that must

take a beating

the best base is fast-setting

No. 1340 BECKOSOL

If you formulate enamels for implements, toys or other air-dry and baking purposes, you'll do well to get acquainted with this new, modified Beckosol solution. It possesses good durability, and its adhesion, gloss, and resistance to abrasion, weather, acids, oil and grease are excellent. Rapid set and fast hardening are other advantages that make No. 1340 Beckosol an especially valuable time-saving, reputation-building base. Write direct to the Sales Department at Detroit for samples and formulation details.

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B&A

BAKER & ADAMSON QUALITY

STANDARD OF PURITY

FOR AMERICAN INDUSTRY

For Your Fine Chemical Needs Rely on General Chemical's Baker & Adamson Division*

B&A AMMONIUM SULFATE *Purified*

Purified Ammonium Sulfate by B&A is a white granular product assaying 99% min. $(NH_4)_2SO_4$, which is eminently suitable for industrial microbiology and the preparation and manufacture of medicinals. This B&A purity product is *not* a coal tar derivative but a basic process chemical produced by B&A from virgin raw materials.

Low in iron, lead and arsenic, it provides a quality product for such exacting uses as: precipitation of proteins from serums and biologicals . . . as a source of nitrogen in synthetic media as in vitamin manufacture . . . medium for yeast culture in fermentation . . . treatment of surgical gut, etc.

In addition, its high purity will prove advantageous for other industrial applications, including: processing of animal bone glue; softening of casein-formaldehyde resins; production of aluminum alloys; ingredient of flame-proofing compositions, for paper, textiles, wood, etc.

B&A CADMIUM NITRATE, CRYSTAL *Reagent and Purified*

This B&A quality chemical is available in two high purity forms: the reagent, which assays 99% min. $Cd(NO_3)_2 \cdot 4H_2O$, and the purified, which assays 98%. Strict specifications and rigid production control result in materials consistently low in undesirable impurities in either grade. Thus, Industry has an excellent selection to choose from for such applications as: the preparation of pure cadmium oxide (used as an ingredient in certain petroleum polymerization catalysts and in fluorescent materials for lamp manufacture); the manufacture of cadmium yellow for coloring porcelain, pottery and glass; and such patented applications as in a solution for refining cracked petroleum distillates, as a catalyst for hydrogenation of oxides of carbon, and in preparing a catalyst for oxidation of hydrocarbons.

B&A SODIUM PHOSPHATE, DIBASIC *U. S. P.*

In the manufacture of saline laxatives and cathartics, urinary acidifiers, or other pharmaceuticals, when your process calls for U.S.P. Disodium Phosphate ($Na_2HPO_4 \cdot 7H_2O$), you can depend upon Baker & Adamson to meet your production schedule month after month with a pure, crystalline product.

Made with all the priceless experience B&A has gained in 65 years of producing reagent chemicals to "decimal-point" purity, this material will answer food processing requirements, too. These include such varied applications as in the production of processed cheeses and ice cream, in producing quick cooking cereals, and as an ingredient in wine clarifying compositions, etc.

★ This is the fifth in a series of advertisements reviewing the B&A Fine Chemicals commercially available to American Industry today from the Baker & Adamson Division of General Chemical Company.

Scores of such purity products await your investigation. To learn more about these or other B&A Fine Chemicals that meet your requirements, write or 'phone the nearest B&A Sales and Technical Service Office at right.

GENERAL CHEMICAL COMPANY

BAKER & ADAMSON DIVISION

40 RECTOR STREET, NEW YORK 6, N. Y.

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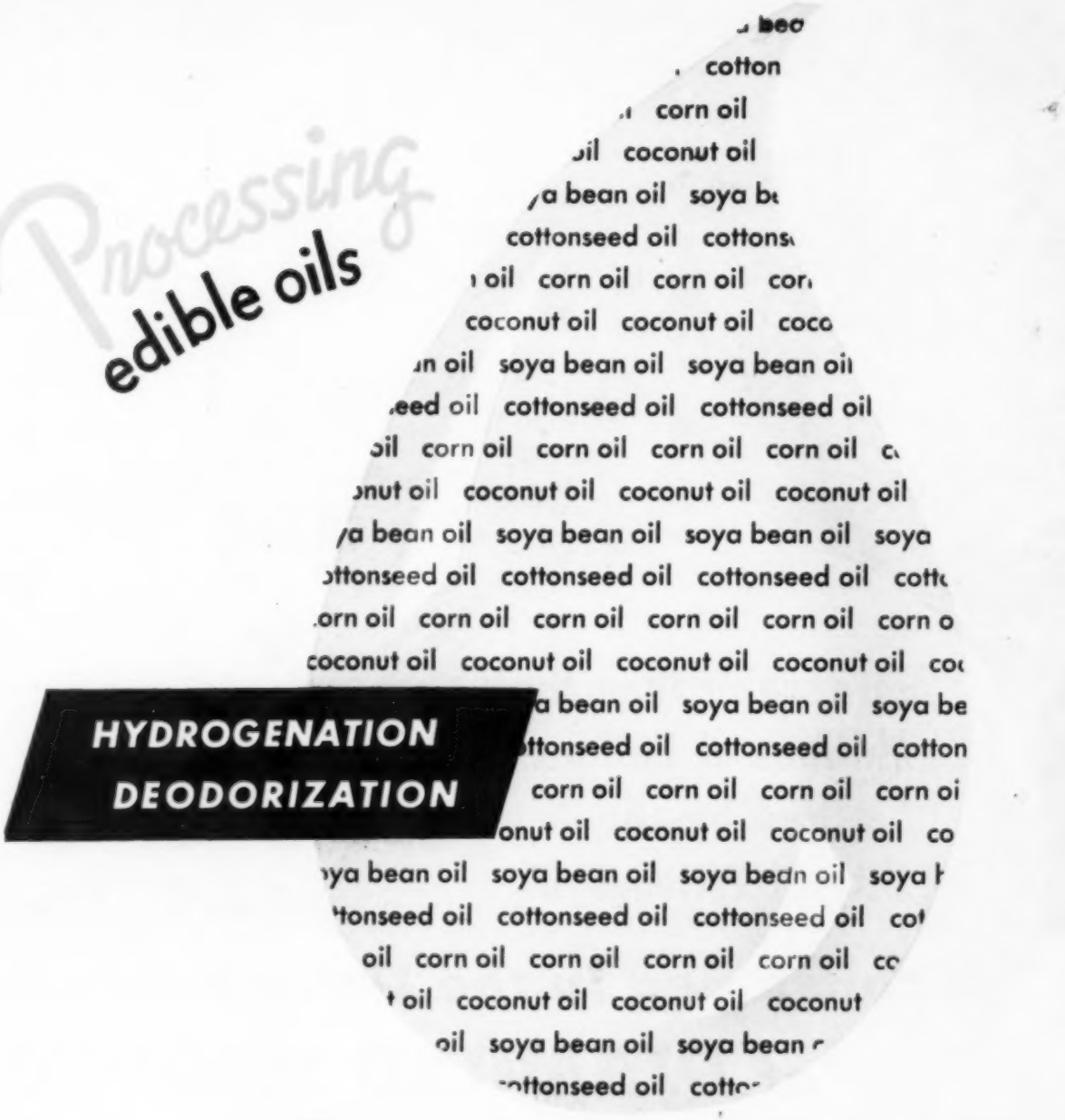
SETTING THE PACE IN CHEMICAL PURITY SINCE 1882

* Complete stocks carried here.



EACH DROP of processed oil of uniform purity . . . Foster Wheeler offers industrial processors the most recent developments in applied chemistry for hydrogenation and deodorization.

The Foster Wheeler service is complete, and includes determination of the processing cycle . . . design of equipment to be employed . . . construction of equipment in our own manufacturing plants. One organization — one responsibility.

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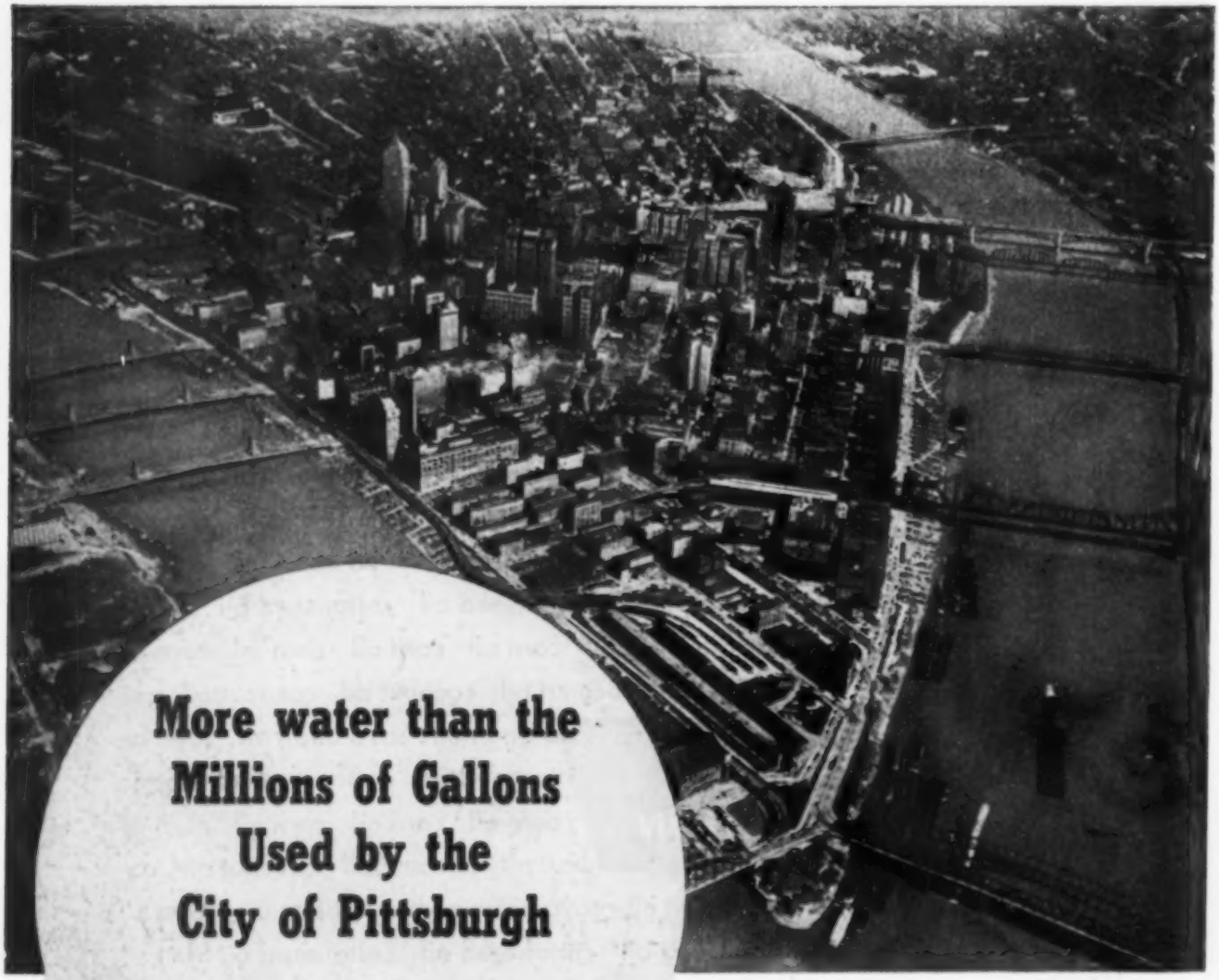


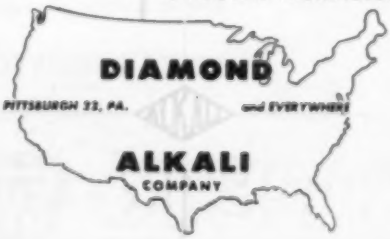
More water than the Millions of Gallons Used by the City of Pittsburgh

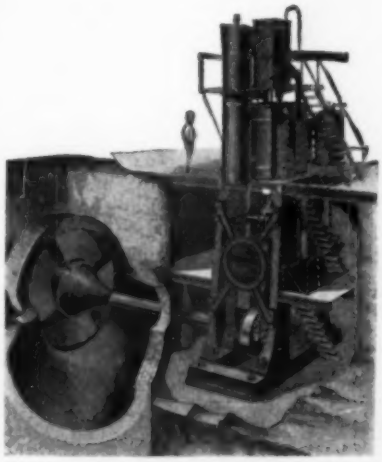
Is consumed in the Daily Production of DIAMOND PRODUCTS

Water . . . one of the basic raw materials used in the processing of alkalies and chemicals, pours into Diamond's plants by more than a hundred million gallons daily. This is greater than the water needed to supply the homes and industries of a city the size of Pittsburgh.

To handle this enormous volume of water, along with thousands of tons of limestone, coal and salt, DIAMOND facilities are constantly being expanded and improved to better meet the ever-increasing demand for DIAMOND quality products, and to continue to merit the confidence placed in us by industry.

SODA ASH
CAUSTIC SODA
BICARBONATE OF SODA
SILICATE OF SODA
LIQUID CHLORINE
CARBON TETRACHLORIDE
CALCIUM CARBONATES
SPECIAL ALKALIES





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of experience building centrifugal pumps

PLUS
Experience building electric motors for

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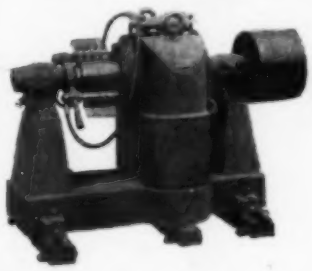

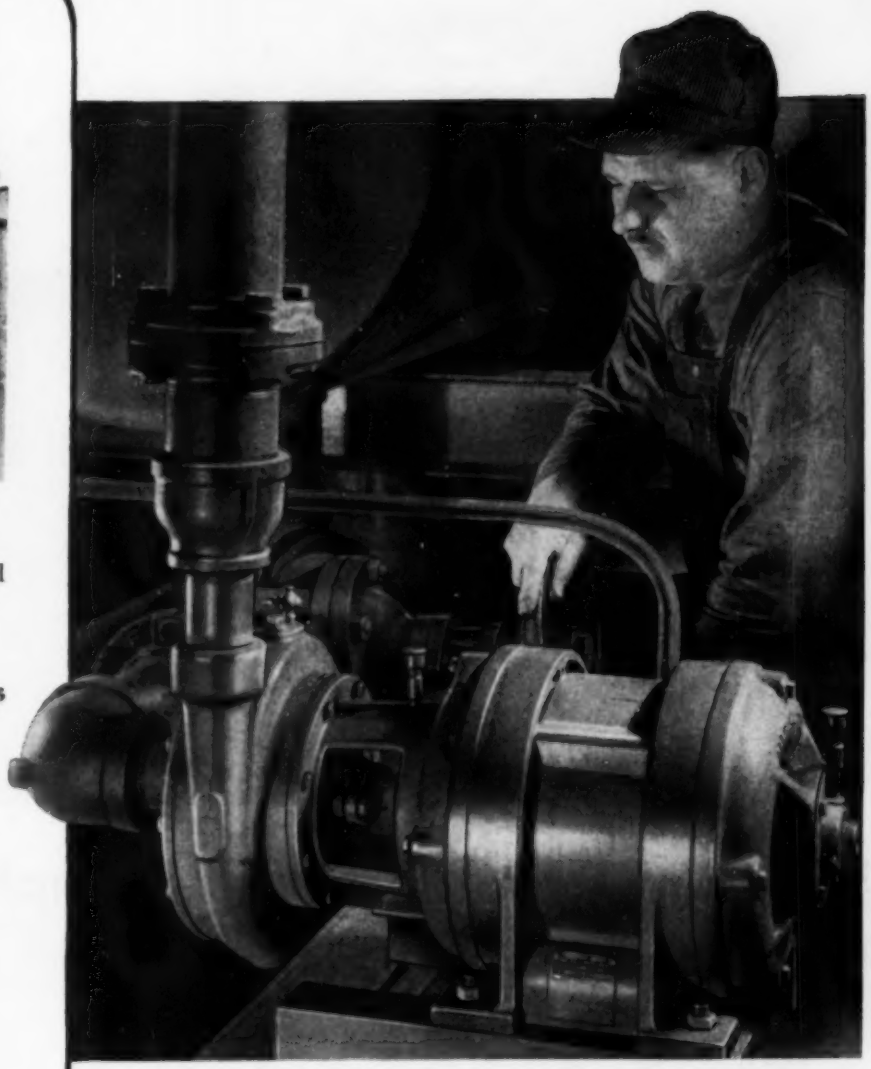

Allis-Chalmers SS-Unit Pump — extremely versatile, low in cost, high degree of efficiency. A single suction centrifugal pump and motor, designed and built as a compact unit. In 234 standard ratings, 10 to 2,500 gpm, heads to 575 ft.

...122 Years Combined Experience applied to YOUR pumping problems!

YOU'RE GOING to headquarters when you call on Allis-Chalmers for pumps! No other manufacturer can offer you the wealth of *combined* centrifugal pump and motor experience. This is important, too. For pump and motor must be designed and matched as a team to assure a pumping unit of highest efficiency, economy and reliability. Undivided responsibility is a further guarantee of satisfaction over the years.

What are your requirements? Allis-Chalmers offers large or small pumps to operate at high or low heads. — Also, special pumps to handle liquids of high solid content and corrosive or abrasive liquids. Call your nearest A-C office, see Sweet's, or write for Bulletin 6059-D. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

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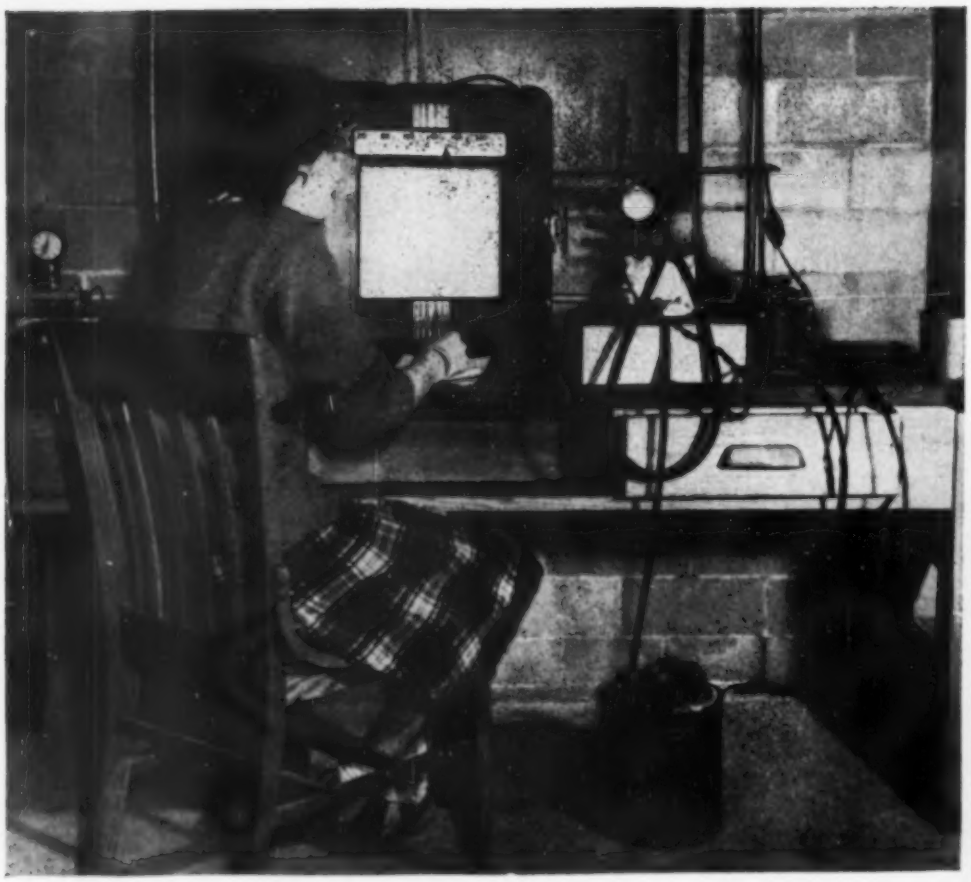

Data Are Recorded *Ultra-Promptly* With *Speedomax* Instruments

Because speed of measurement is all-important in testing their thermostats, Vernay Laboratories, Inc., has assembled the Speedomax Recorder and other equipment shown above to provide an automatic record, both of temperature and of temperature change.

The bowl at the right of the Speedomax, and in the photo at right, holds the Vernatherm power thermostat under test, and water for heating. The fine-wire thermocouple detects water temperature for the Speedomax.

After using the equipment, Vernay engineers say that Speedomax gives the test the following characteristics:

1. Overall speed of measurement is "several times" greater than with any other method used. Record is automatic.
2. Temperature range can be as wide as desired.
3. Record shows many fluctuations which manual charts miss.
4. Minimum technical skill is required to run the tests.

Speedomax Type G Recorder is described in Catalog ND46(1), sent on request, or an L&N engineer will write or call if you prefer.

Write for this catalog

LEEDS & NORTHRUP COMPANY, 4916 STENTON AVE., PHILA., PA.

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